SOIL SURVEY

Tuscarawas County Ohio

Series 1938, No. 32

Issued December 1953

This number is the last Soil Survey Report for the year 1938

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
OHIO AGRICULTURAL EXPERIMENT STATION

How To Use THE SOIL SURVEY REPORT

FARMERS who have worked with their soils for a long time know about the soil differences on their farms, perhaps also on the farms of their immediate neighbors. What they do not know, unless soil surveys have been made, is how nearly their soils are like those on experiment stations or on other farms, either in their State or other States, where farmers have gained experience with new or different farming practices or farm enterprises. They do not know whether higher yields obtained by farmers in other parts of their county and State are from soils like theirs or from soils so different that they could not hope to get yields as high, even if they followed the same practices. One way for farmers to do away with some of the risk and uncertainty involved in trying new production methods and new varieties of plants is to learn what kinds of soils they have so that they can compare them with the soils on which new developments have proved successful.

SOILS OF A PARTICULAR FARM

The soil map is in the envelope inside the back cover. To find what soils are on any farm or other land, it is necessary first to locate this land on the map. This is easily done by finding the township in which the farm is located and by using landmarks such as roads, streams, villages, dwellings, and other features to locate the boundaries.

Each kind of soil mapped within the farm or tract is marked on the map with a symbol. For example, all the areas marked Cd are Chagrin silt loam. The color in which the soil area is shown on the map will be the same as the color indicated on the legend for the particular type of soil. If you want information on the Chagrin soil, turn to the section in this publication on Soil Types and Phases and find Chagrin silt loam. Under this heading you will find a statement of what the characteristics of this soil are, what it is mainly used for, and some of the uses to which it is suited.

Suppose, for instance, you wish to know how productive Chagrin silt loam is. You will find it listed in the left-hand column of table 16. Opposite the name you can read the yields for different crops grown on the soil. This table also gives estimated yields for all the other soils mapped in the county.

If, in addition, you wish to know what good use and management practices are recommended for Chagrin silt loam, read what is said about this in the section on Soil Types and Phases. Refer also to the section headed Use, Management, and Productivity of the Soils of Tuscarawas County, where the soils suited to the same use and management practices are grouped together.

SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils of the county is given in the section on Soils, which tells about the principal kinds of soils, where they are found, and how they are related to one another. After reading this section, study the soil map and notice how the different kinds of soils tend to be arranged in different parts of the county. These patterns are likely to be associated with well-recognized differences in types of farming, land use, and land use problems.

A newcomer to the county, especially if he considers purchasing a farm, will want to know about the climate; the types and sizes of farms; the principal farm products and how they are marketed; the kinds and conditions of farm tenure; availability of roads, railroads, and electric services; water supplies; industries of the county; and cities, villages, and population characteristics. Information about all these will be found in the sections on General Nature of the Area and on Agriculture.

Those interested in how the soils of the county were formed and how they are related to the great soil groups of the world should read the section on Morphology and Genesis of Soils.

This publication on the soil survey of Tuscarawas County, Ohio, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

And the

OHIO AGRICULTURAL EXPERIMENT STATION

Series 1938, No. 32 Issued December 1953

SOIL SURVEY OF TUSCARAWAS COUNTY, OHIO [1]

By ROBERT WILDERMUTH, in Charge, ARTHUR E. TAYLOR, and MATTHEW DROSDOFF, Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, and W. S. MOZIER, G. A. MICKELSON, and R. W. CUMMINGS, Ohio Agricultural Experiment Station

Area inspected by O. C. ROGERS, Senior Soil Scientist, Division of Soil Survey

United States Department of Agriculture in cooperation with the Ohio Agricultural Experiment Station

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[1] The field work for this survey was done while the Division of Soil Survey was a part of the Bureau of Chemistry and Soils. The Division was transferred to the Soil Conservation Service on November 15, 1952.

TUSCARAWAS COUNTY is in a strongly dissected part of the Allegheny Plateau where climate favors a combination of general farming and dairying. Hay, corn, winter wheat, and oats—leading crops in the order named—are in large part fed to livestock raised on the farms or purchased for fattening and resale. Coal mining, processing of dairy and other farm products, and manufacturing of steel, iron, electrical, and lumber products are among the stable and diversified industries in the county that provide markets for farm produce. Railroads and hard-surfaced highways offer ready access to markets. To provide a basis for the best agricultural uses of the land, this cooperative soil survey was made by the United States Department of Agriculture and the Ohio Agricultural Experiment Station. Field work was completed in 1938, and, unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Tuscarawas County, located in the east-central part of Ohio, is roughly rectangular; its greatest north-south length is about 30 miles, and its greatest east-west width about 23 miles (fig. 1). New Philadelphia, the county seat, located in approximately the center of the county, is about 70 miles south of Cleveland, 85 miles northeast of Columbus, and 185 miles northeast of Cincinnati.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The county lies within the western part of the Allegheny Plateau.[2] Before stream dissection formed valleys this region was a plain sloping gently toward the south, and plateau-like features still can be observed from any of the numerous ridge tops, the perspective of relief across the crest of the ridges giving the impression of a plain-like area.

The general elevation of the ridges differs little over most of the county, but a few isolated hills and knobs are distinctly higher. These

[2] FENNEMAN, N. M. PHYSIOGRAPHY OF EASTERN UNITED STATES. 714 pp., illus. 1938.

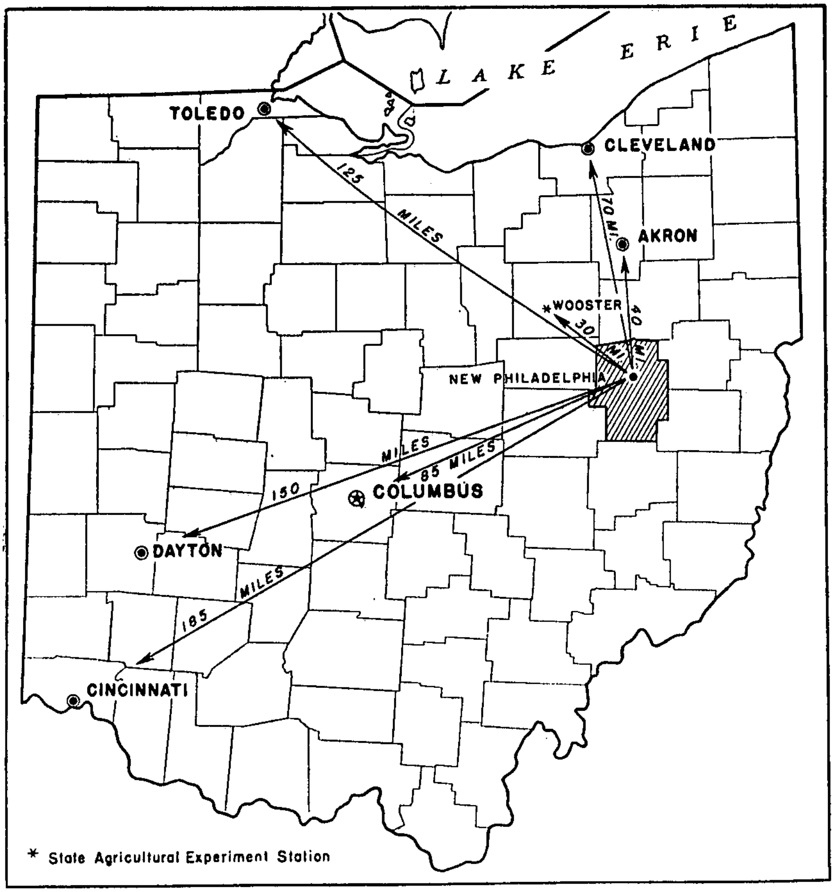

FIGURE 1.—Location of Tuscarawas County in Ohio.

hills and knobs may represent remnants of an older surface of the plateau. The county is now a highly dissected area, with long relatively narrow ridges, moderate to steep slopes, and narrow to broad stream valleys. The main ridges generally are roughly parallel to the drainage and have numerous radiating spur ridges that form a dendritic pattern. The ridges vary from less than 50 to about 1,000 feet wide, the main ridge having the greatest width and the spur, or projecting, ridges narrowing toward their outer limits.

Characteristically, the slopes have a greater width than the ridge tops, and the distance between ridge tops frequently ranges from ½ to 1 mile. The intervening space is occupied by the slopes and relatively narrow stream bottoms. Owing to the unequal resistance of the bedrock formation, the steepness of the slope is not uniform and often varies considerably in short horizontal distances. In general, a slope is the steepest at its upper part and gradually decreases in gradient to the adjoining terraces or flood plains. Locally some of the longer slopes have a bench, or steplike, relief, with narrow areas of smooth to gently sloping relief alternating with abrupt steep slopes.

Some areas, particularly those adjacent to or approaching the Tuscarawas River and the Stillwater Creek valleys, are extremely rugged, with very steep V-shaped valleys or ravines.

The Allegheny and Conemaugh divisions of the Pennsylvanian geologic age are the bedrock formations in this county. The Conemaugh formations are exposed chiefly in the southeastern part, principally in parts of Perry, Rush, Washington, Oxford, Clay, and Mill Townships. The Allegheny formations, consisting of interbedded sandstone, siltstone, shale, and clay shale, with some fire clay, limestone, and coal, occupy the rest of the county. The northwestern part of the county is dominated by clay shale, with minor layers of sandstone. In this area, west of Sugar Creek valley, and north of a line extending from Shanesville to Parral, the ridge tops are wider and the slopes gentler than in other parts of the county.

The various formations are extremely variable in thickness and sequence, and this accounts for the complex soil conditions that occur on sloping areas. Locally the bedrock layers appear to be nearly horizontal, but toward the southeast there is a dip of about 25 feet to the mile.

A small area (about 2 square miles) in the extreme northwestern part of the county was covered by Wisconsin glaciation. The glacial drift is relatively shallow and composed chiefly of sandstone and shale material. It represents the extreme southward advance of the Wisconsin glaciation that covered large parts of counties lying to the north. Although the glacial deposits are relatively thin, the glacier modified the relief.

The Tuscarawas River and its tributaries drain the county. The river enters the northeastern part of the county, flows southeast to Valley Junction, then southwest to Dover and Midvale, and thence to Newcomerstown, where it leaves the county. The principal tributary is Stillwater Creek, which enters the county at the southeastern corner, flows northwest, and enters the Tuscarawas River in the vicinity of Midvale. Sugar Creek, another smaller tributary stream, enters the county near the northwestern corner, flows southeast, and unites with the Tuscarawas River at Dover. Numerous other smaller creeks and drainageways traverse the county and together form a dendritic drainage pattern.

Before the last glacial period the streams of the county generally flowed northward, but with advance of the ice sheet this flow was obstructed. Water from the melting ice sheet to the north flowed across the county through existing valleys or formed new ones, carrying with it large quantities of gravel and sand and some silt. The ice sheet caused ponding of the north-flowing streams and allowed large quantities of silt and clay to be deposited in the relatively quiet water, especially in the valleys south of the Tuscarawas River. Since these materials were deposited, streams have cut to lower levels, and the valleys now consist of a series of broad terraces, high bottoms, and flood plains. The more extensive areas of deposit are in the valleys of the Tuscarawas River and Sugar and Stillwater Creeks, with smaller terraces in the valleys of the smaller streams.

In most of the county the ridges are about 1,100 to 1,200 feet above sea level. There are, however, several higher conspicuous knobs, or

points:[3] 1,327 feet, 2 miles west of Gilmore; 1,300 feet, 1¾ miles southeast of Roxford; 1,249 feet, at Tabor School in Fairfield Township; and 1,236 feet, 1 mile south of Germany School in Wayne Township. The elevation of some of the population centers is as follows: Bolivar, 899 feet; Dover, 898; Zoar, 898; Port Washington, 818; and Newcomerstown, 809 feet.

CLIMATE

The climate of the county is continental, humid, and temperate, with moderately cold winters and warm humid summers. Characteristically there are sudden changes in temperature and general climatic conditions. Detailed climatic data compiled from records of the United States Weather Bureau station at Dennison are given in table 1.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Dennison, Tuscarawas County, Ohio*

[Elevation, 846 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	32.3	70	−20	2.92	1.25	2.37	4.2
January	29.9	70	−25	3.25	3.78	2.35	7.7
February	31.0	73	−21	2.33	2.18	3.12	6.9
Winter	31.1	73	−25	8.50	7.21	7.84	18.8
March	39.8	85	0	3.29	2.33	7.89	4.0
April	50.5	93	5	3.10	1.38	4.48	1.1
May	60.6	99	25	3.59	2.36	4.88	(1)
Spring	50.3	99	0	9.98	6.07	17.25	5.1
June	69.4	101	32	4.15	1.89	4.35	0
July	73.2	105	38	4.05	1.15	4.07	0
August	71.5	105	37	3.76	2.54	1.68	0
Summer	71.4	105	32	11.96	5.58	10.10	0
September	65.6	97	29	3.19	2.75	7.61	0
October	53.9	90	15	2.85	1.25	2.96	.2
November	42.0	76	0	2.64	1.31	4.87	2.0
Fall	53.8	97	0	8.68	5.31	15.44	2.2
Year	51.6	105	−25	39.12	[2] 24.17	[3] 50.63	26.1

[1] Trace. [2] In 1930. [3] In 1945.

[3] Elevations from U. S. Geological Survey bench marks.

The mean temperature for the year is 51.6° F., but there are wide variations—from a minimum of −25° to a maximum of 105°. These variations cause considerable damage to fall-sown small grains, clovers, and alfalfa when occurring suddenly and with alternate freezing and thawing not accompanied by snow. If protected by a snow cover, wheat and other fall-sown small grains will withstand extremely low temperatures. Probably the greatest injury results from low temperatures when the soil is saturated and an ice coating forms over the plants. Injury to crops is thus more pronounced on areas where drainage is not sufficient and on low-lying areas where water stands for considerable periods. Nevertheless, damage is not frequent enough to discourage growing crops, except on some of the more poorly drained areas. The general farm crops are not often seriously affected by the temperatures in summer; however they may be damaged when the temperature approaches freezing and when high temperatures occur during periods of drought.

The average frost-free season of 151 days, from May 9 to October 8, is usually ample for growing and maturing most crops common to the county. Some crops, however, are injured by late spring or early fall frosts. Vegetables, fruit, and occasionally corn are injured by late spring frosts. When seasonal conditions delay the planting of corn, soybeans, tomatoes, and vegetables, or excessive moisture in fall prevents their maturing, injury may result from early fall frosts. Killing frost has occurred as late as June 15 and as early as September 3. When these extremes occur, general crop damage usually is severe.

Precipitation is usually adequate for the growth and maturation of the crops. The mean precipitation for the growing season—April to September, inclusive—is 21.84 inches, or about 55 percent of the total. The average annual snowfall is 26.1 inches, with 18.8 inches, or about 72 percent, occurring in December, January, and February.

Climatic conditions differ somewhat according to location. Areas with elevations of 1,000 feet or more usually have greater variation in temperature, movement of warm and cold air currents, evaporation, frost, and intensity of wind movement than associated valley areas several hundred feet lower in elevation. Frosts may occur, however, on low-lying areas when there are no frosts on the adjacent slopes This fact is important in the location of orchards.

Slope exposure is another relief feature that modifies local temperature. Slopes with a southern exposure receive more sunlight than slopes facing north. Consequently, ground temperatures and evaporation are higher on slopes with southern exposures. These conditions are reflected in the kinds of native and farm plants and in their growth.

Hailstorms are extremely local and occur infrequently. When hail does come, damage is severe on the few farms in the path of the storm.

WATER SUPPLY

Water for household use and for livestock is obtained from wells drilled into the bedrock formations of the upland, the gravelly and sandy terrace areas, silt and clay terraces, and the alluvial flood plains.

The supply from bedrock is usually not so dependable as that from other sources. Water for general use is obtained from springs, which usually occur on hillsides; rivers and streams furnish water for livestock. Wells drilled into the gravel terraces and flood plains, rivers, and streams supply water for the industries.

This county is one of 18 in eastern Ohio which, in part or entirely, form the Muskingum Conservancy District. The district, the largest of its kind in Ohio, is part of a project designed for flood control and water and soil conservation in the watershed of the Muskingum River. The undertaking involved the construction of 14 dams, 4 of which are located in the county. The Tuscarawas River, flowing through the central part of the county, is one of the principal tributaries of the Muskingum River.

The project in Tuscarawas County included not only the construction of dams but the relocation of a large mileage of highways, railroads, power and gas lines, and many farm homes. A large acreage of farm land behind the dams was purchased by the Conservancy District, and flood easements were obtained on a number of farms. In addition to flood control, State and Federal agencies are engaged in other important activities throughout the district, including control of soil erosion, wildlife restoration, reforestation, studies of climate and rainfall, and recreational development.

VEGETATION

An excellent stand of mixed hardwoods originally covered the entire county. The principal species on the uplands were white oak (*Quercus alba*), black oak (*Q. velutina*), hickory (*Carya* sp.), tuliptree (yellow-poplar) (*Liriodendron tulipifera*), American elm (*Ulmus americana*), maple (*Acer* sp.), and ash (*Fraxinus* sp.). The bottoms supported a growth of sycamore (buttonwood) (*Plantanus occidentalis*), linn or basswood (*Tilia americana*), willow (*Salix* sp.), and associated species. Some records indicate that the terraces in the valley of the Tuscarawas River were sparsely timbered when white men first came. The tree growth there, however, was similar to that on the adjacent hills.

No areas of virgin timber remain in the county, and the areas now forested have largely a second-growth consisting of some of the original species. The forest includes a mixture of oak, ash, maple, hickory, tuliptree (yellow-poplar), buckeye (*Aesculus glabra*), birch (*Betula lenta*), blackgum (*Nyssa sylvatica*), and basswood, with some white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*), and cucumbertree (*Magnolia acuminata*). Many of these areas have an understory of blackberry (*Rubus* sp.), black locust (*Robinia pseudoacacia*), and sassafras (*Sassafras albidum*), together with seedlings of the trees. Thick stands of locust have become established on many of the coal mine dumps.

Many of the steeper slopes and long narrow ridge tops are in forest. Little merchantable timber now remains, though there is some selective cutting for cross ties or firewood. Many cleared areas that are idle or have been abandoned have a cover of broomsedge, poverty grass, sassafras, sumac, and briers.

ORGANIZATION, SETTLEMENT, AND POPULATION

At an early date hunters and trappers came to the Tuscarawas River valley, which was inhabited by a tribe of Delaware Indians. Missionaries found their way to this region as early as 1762. In 1772 David Ziesberger, a Moravian missionary, and some of his followers from Pennsylvania established Schoenbrun on the banks of the Tuscarawas River. This was the first settlement attempted in the Northwest Territory under civil government. The Schoenbrun mission tried to Christianize the Indians but lasted only about 4 years because of unfriendly Indian tribes who were allies of the British forces during the Revolutionary War. Under Moravian influence a mission was established at Gnadenhutten. A massacre by hostile whites in 1782, together with the unfriendliness of the Indians, discouraged further settlement. German members of the Moravian church in Pennsylvania resumed settlement in 1799. Other religious sects followed. The Amish came early and located along Sugar Creek, where descendants of these early pioneers still live. Dunkards and Mennonites also came.

Tuscarawas County was formed from the Territory of Muskingum by an act of the State Legislature in 1808. At the time of its formation, the population was about 1,000. The early pioneers from Pennsylvania were mainly of German descent, but there were settlers also from Virginia and New York, including many of English, Swiss, and Irish ancestry. The settlers in the southeastern and eastern parts of the county were mainly Irish, whereas many Germans were in the valleys and western part.

In 1817 the county was the site of the Society of Zoar, a group who left Germany because of religious persecution. They combined their small resources to make part payment on land in Lawrence Township along the Tuscarawas River. The system of private property was abolished. Each member contributed time and labor to the society and in return received the necessities of life. The efforts of the society were mainly agricultural, but gristmills, iron furnaces, and a woolen factory were established to provide employment and income. The society existed for about 80 years and was then disbanded because of internal strife.

The population of the county is concentrated in valleys and along the main roads. Cities and important villages are in the valleys of the Tuscarawas River and Stillwater Creek. According to the 1950 census, the total population was 70,320. The average density of the rural population was about 127.6 persons per square mile. Much of the population classified as rural, however, is located in some of the smaller towns and trading centers.

New Philadelphia, laid out in 1804, is the county seat and largest city, with 12,948 inhabitants in 1950. Together with Dover (pop. 9,852) adjoining it on the north, it forms a composite community having the largest concentration of people in the county. Dennison and Uhrichsville, with their respective populations of 4,432 and 6,614, are twin communities in the Stillwater Creek valley. Newcomerstown, founded in 1828 in the southwestern part of the county, is near the site of the onetime capital of the Delaware Indian Nation. Other

important but smaller trading or industrial centers are Port Washington, Gnadenhutten, Strasburg, Dundee, Mineral City, and Zoar.

INDUSTRIES

The county is noted for its stable and diversified industries, which among other things, manufacture brick, sewer pipe, and other clay products. Coal mining affords work for many people. Sand and gravel deposits in the valleys of the Tuscarawas River and other streams are used for construction and road building. Oil and some gas are produced near Newcomerstown. Steel, iron, electric, lumber, and refractory plants and a variety of other manufacturing concerns are located in New Philadelphia and Dover. Much of the milk produced is manufactured into Swiss cheese by cooperative organizations or by private individuals.

PUBLIC FACILITIES

Railroad facilities, available only in valley areas, are furnished by the Pennsylvania Railroad, Baltimore & Ohio Railroad, and Wheeling and Lake Erie Railway Company. Freight service only is extended to the communities along some of the railroad lines. A large part of the clay products, coal, and some of the gravel and sand are transported by railroad. Until the advent of hard-surfaced highways and motortrucks, most of the livestock, livestock products, and grain were also transported by rail.

A network of hard-surfaced highways—United States Highway Nos. 21, 36, and 250, and several State highways—traverse the county. The main county roads are graveled or hard surfaced. According to the 1945 Federal census, 2,325 farms reported being within 0.2 mile of the nearest all-weather road; 360, from 0.3 to 0.9 mile; 258, from 1 to 4.9 miles; and 2, more than 5 miles away. Marketing methods in the county have changed with the establishment of a good system of roads and the increased use of motortrucks.

Formerly the school system consisted of numerous small one- and two-room schools, but in recent years there has been a trend toward large consolidated schools located at convenient points. The children are transported largely by motorbus. Numerous churches serve the various religious groups.

Free mail delivery is available to all districts. Telephone service is available to many sections; the 1945 census reported 786 farms served by telephone. Electric service is generally available, and in 1945, 2,330 farms reported dwellings within ¼ mile of electric distribution lines.

AGRICULTURE

Agricultural development began about 1772 with the coming of the Moravians. They brought 71 head of cattle, which were the first domestic farm animals in Ohio. Livestock was raised both for meat and for dairy products. Few farms were used for stock raising exclusively, although sheep raising was important. Agriculture was primarily on a home-use basis—a pioneer type of cultivation neces-

sarily prevailed, and the first crops were planted Indian fashion among deadened trees. Corn was the first important crop cultivated, but in a few years wheat, rye, oats, barley, flax, hay, and potatoes were grown. Prior to the construction of the Ohio Canal, tobacco was grown in considerable quantity, packed in hogsheads, and hauled by team to Baltimore, Md. Efforts were soon directed to more remunerative crops.

Topography greatly influenced agricultural practices. Most of the earlier attempts at cultivation were made in the small stream valleys and on nearby slopes. The most heavily timbered areas were sought first, for the early settlers judged fertility of land according to the size and growth of timber. The hilly land, consisting of a succession of sharp winding ridges separated by deep narrow valleys, included a large percentage of land too steep for general crop farming. Much of the land in the county, as a consequence of relief, was used for permanent and woodland pasture. Wheat was the staple crop on farms in the hill lands; corn was the dominant crop for those on the alluvial soils.

CROPS

Corn was the most important cereal crop in total acreage in 1944. However, the total corn acreage had decreased in the last 25 years because of the increase in acreage of soybeans, the growing of more pasture crops, and the use of a longer rotation system in which corn is grown only once every 4 or 5 years. The average acre yield has increased partly because of differences in weather but generally because of the increased use of hybrid seed corn. The largest acreage and highest yields are on alluvial and terrace soils.

Land to be used for corn is plowed either in fall or early in spring, depending upon weather conditions and the soil type. Fall plowing increases erosion, especially on the more rolling areas, and consequently the greater part of the cornland is plowed in spring. The ground is usually thoroughly disked and smoothed with either a harrow or cultipacker before planting. Machinery, including tractors, is in general use on the larger bottoms and terraces, with a somewhat limited use on the uplands. Corn is planted in May, in normal seasons from May 15 to 30. A few mechanical pickers are in use but the greater part of the corn is cut and placed in shocks to be husked later. The fodder is used for roughage feed and bedding for cattle and horses.

Most of the wheat grown is winter wheat; it is sown in fall, usually after the fly-free date (date at which the hessian fly ceases to be a danger) as given by the Ohio Agricultural Experiment Station. Wheat may follow corn, soybeans, or oats in the rotation system, or may be sown on land where hay crops have failed. It is general practice to use commercial fertilizer with wheat, the quantity and analysis varying considerably. Some farmers top dress the crop with barnyard manure in winter or early in spring. Wheat is usually cut with a grain binder and placed in shocks to be threshed later. It is marketed largely through local elevators as a cash crop. Relatively small quantities are retained on the farm for seed, and in years of reduced supply of other feeds it is ground and fed to dairy cows and other livestock.

Oats usually follow corn, wheat, or soybeans in the rotation, or they may be sown where hay crops have failed. They are seeded in April or early in May, depending on the weather. Yields are, in general, larger when seeding is early, but prolonged hot dry weather during any part of the growing and ripening season will materially reduce the yield.

Rye always has been a minor grain crop. Methods of seeding and harvesting are essentially the same as for wheat, although rye usually is seeded somewhat earlier in fall and little commercial fertilizer is used. It is often pastured for a few weeks in spring before other pasture is available. The grain generally is ground and used for livestock feed.

The acreage of soybeans grown alone is increasing. Soybeans are grown after corn or small-grain crops and are usually planted late in May or in June. Much of the crop is cut for hay, but the proportion cut for beans has increased in the last few years. A good seedbed is essential, as is thorough weed control both before and after planting. Seed should be inoculated until the soil in the producing field carries abundant inoculation. For maximum feeding value of the hay, the seed should be well developed in the pod before harvest.

Other cereal and grain crops grown to a limited extent are barley, sorghum, buckwheat, and cowpeas. Usually they do not have a place in the rotation but are grown as emergency crops on areas where some other crop has failed.

The acreage in hay crops has always been greater than that in any other crop. Most of the soils are medium to strongly acid, and a majority of the farmers do not attempt to grow alfalfa and clover until sufficient lime, usually in the form of ground limestone, is applied to bring the reaction of the soil to pH 6.0 or higher. Inoculation of the seed is essential for the most successful growth and for nitrogen fixation by the plants. Timothy and clover are grown alone or mixed; some alsike clover and alfalfa are included in the stand. A small acreage of sweetclover is grown. The acreage of small grains used for hay fluctuates from year to year but is never large.

Market vegetables are grown largely on the terraces and bottom areas of the county, principally in the vicinity of the larger towns. Sweet corn was grown on 178 acres in 1944, snap beans on 140, cabbage on 45, tomatoes on 28, and other vegetables and melons on 147. There were 850 acres of Irish potatoes grown in 1944, with an average yield of 112 bushels per acre. It is common practice to use large quantities of commercial fertilizer with vegetables.

The acreage of the principal crops and number of bearing fruit trees, as reported by the United States census in stated years, are given in table 2.

TABLE 2.—*Acreage of the principal crops and number of bearing fruit trees in Tuscarawas County, Ohio, in stated years*

Crop	1919	1929	1939	1944
Corn:	*Acres*	*Acres*	*Acres*	*Acres*
For grain	22, 486	15, 901	19, 022	22, 486
For silage, fodder, and other purposes	[1] 8, 693	3, 546	2, 892	3, 282
Wheat threshed	30, 113	17, 721	16, 250	16, 989
Oats:				
Threshed	20, 396	14, 718	10, 118	9, 593
Cut and fed unthreshed	(2)	283	192	251
Rye, threshed	524	460	661	190
Barley, threshed	80	1	16	99
All hay	46, 989	38, 382	34, 616	37, 278
Timothy and clover, alone or mixed	46, 324	37, 360	27, 821	31, 772
Alfalfa	201	339	2, 605	4, 019
Annual legume hay	100	414	2, 699	1, 108
Small-grain hay	57	59	387	75
Other tame hay	243	192	1, 031	268
Wild hay	64	18	73	36
Soybeans	(2)	409	3, 134	2, 082
Potatoes	1, 679	1, 313	993	850
Market vegetables	(2)	360	611	538
	Number	*Number*	*Number*	*Number* [3]
Apples ... trees	92, 176	76, 345	48, 623	60, 023
Peaches ... do	61, 126	46, 060	44, 197	54, 480
Cherries ... do	16, 273	9, 544	4, 863	7, 446
Grapevines	9, 589	15, 440	16, 168	17, 819

[1] For forage only.
[2] Data not available.
[3] 1945 figures are for trees and vines of all ages.

ROTATIONS AND FERTILIZERS

Crop rotations used on the upland areas consist largely of corn, wheat or oats, and hay, mainly timothy and clover grown alone or mixed. The rotation is varied to include soybeans, rye, and some other field crops. A rotation of corn, wheat, oats, soybeans, and hay is used by some farmers. There is a trend, in some parts of the county, to a rotation that includes more hay and small-grain crops and less clean-cultivated crops. On the nearly level alluvial flood plains, especially those subject to frequent flooding, rotations include corn for several consecutive years, or corn for 2 or 3 years and soybeans for 1 year. These rotations are varied to include vegetables and special crops.

The use of commercial fertilizer is general throughout the county. Fertilizer is largely purchased ready-mixed, but a few farmers do home mixing. Fertilizer is purchased both cooperatively and individually. The common practice is to fertilize corn, wheat, and vegetables; some fertilizer is used for oats and soybeans. There is a trend toward indirect fertilization of hay crops; larger quantities of fertilizer are applied to wheat, oats, and other small grains for the benefit of the hay crop following. Commercial fertilizer supplemented by barnyard manure is in greater part applied to land that will be planted to corn, or is applied as a top dressing for wheat.

The value of lime for correcting soil acidity is generally recognized, and an increasing quantity, principally in the form of ground limestone, has been used recently. An accurate test should be made to determine the lime requirements of a soil or soils in a given field. This can be accomplished with a number of available acidity indicators. Probably the best procedure is to take samples of the different soils in an area, both surface soil and subsoil, and mail or take them to the county agricultural agent at New Philadelphia, or mail them to the Agronomy Department, Ohio State University, Columbus.

PERMANENT PASTURE

The larger acreages of permanent pasture occur on the rolling upland areas. These pastures are of variable livestock-carrying capacity; their quality is largely governed by the percentage of bluegrass and white clover present. In general, the pastures contain a large percentage of povertygrass and broomsedge and are of only fair quality. A pasture improvement program that includes the use of sufficient lime to correct soil acidity, application of enough commercial fertilizer relatively high in phosphoric acid, and weed control is essential to raise the quality and carrying capacity of most of the pastures. These practices have been applied to some pastures, and more farmers are realizing the necessity of improving their pastures by using fertilizers and practicing weed control. Pastures on the alluvial flood plains along the Tuscarawas River and the larger streams are usually of a better quality and contain a larger percentage of bluegrass than those on the upland areas.

LIVESTOCK AND LIVESTOCK PRODUCTS

Livestock raising has been an important source of farm income in the county for the past 60 years and is the medium through which a large part of the farm crops is marketed.

Dairying is one of the most important branches of the livestock industry. Both specialized and general types are followed. The principal breeds on specialized dairies are Jersey, Holstein-Friesian, and Guernsey. Herds vary in size. The specialized dairies are maintained for the production and sale of whole sweet milk, sweet cream, butter, and other dairy products to the nearby cities, cheese factories within the county, and to milk and creamery companies.

The general type of dairying is maintained on farms that keep a small number of cows. Part of the dairy products are used on the farm, with the surplus sold to cheese factories within the county or to milk and creamery companies whose trucks have daily schedules to the farms. A few purebred types of cattle are kept, but the greater part are good-grade mixed breeds.

Much of the corn, oats, and hay for dairy cattle is grown on the farm, although a large quantity of commercial supplement feed is also used, especially on the larger dairies.

The beef cattle industry is less specialized than dairying and is rather generally distributed over the county. The number of beef cattle per farm is usually small, except on some farms that purchase feeder cattle. These are purchased when small, grazed during the summer, and finished on corn, hay, and commercial supplement feeds. The principal breeds are Hereford and Shorthorn.

A few farmers raise swine in herds of 100 or more head, but usually the herds are much smaller. Although the greater part of the feed for hogs—mainly corn and legume pasture—is grown on the farm, it is supplemented by commercial feeds on most farms.

Sheep are well distributed throughout the county, and, in general, the flocks are not large. Most of the sheep sold are raised on the farm, but a few farmers buy feeder sheep or lambs from outside areas and fatten them.

Chickens and eggs are the major source of income from poultry. Almost every farm has from a few dozen to more than 100 hens, and those farms specializing in poultry have several hundred each. The larger part of the poultry and poultry products is marketed locally, but some farmers, especially those specializing in this industry, ship to outside markets where a premium price generally is obtained for their products.

The increase in mechanized farming has been responsible for the general decrease in the number of horses and mules. The work stock is partly raised on the farm and partly purchased from adjacent areas, but practically all the feed for both horses and mules is grown on the farm.

The number of livestock on farms, as reported by the United States census in stated years, is given in table 3.

TABLE 3.—*Livestock on farms in Tuscarawas County, Ohio, in stated years*

Livestock	1920	1930	1940	1945
	Number [1]	*Number*	*Number*	*Number* [1]
Cattle	25, 308	[2] 21, 015	[2] 23, 648	29, 350
Swine	20, 234	[2] 8, 169	[3] 11, 938	15, 719
Sheep	24, 406	[4] 15, 735	[4] 13, 149	9, 191
Horses	8, 681	[2] 5, 067	[2] 5, 292	4, 464
Mules	221	[2] 163	[2] 245	159
Goats	20	[1] 27	[3] 106	182
Chickens	203, 328	[2] 189, 685	[3] 171, 866	[3] 171, 610

[1] Of all ages.
[2] Over 3 months old.
[3] Over 4 months old.
[4] Over 6 months old.

TYPES OF FARMS

According to the 1945 Federal census, 1,029 farms received their major source of income from farm products used by farm households; 830 from dairy products sold or traded; 322 from livestock; 162 from poultry and poultry products; 90 from field crops; 66 from fruits and nuts; 19 from vegetables; 11 from horticultural specialties; and 10 from forest products. There were 372 general farms and 96 unclassified farms.

LAND USE

In 1944 the total land in farms in the county was 285,298 acres. Of this total, 96,390 acres was cropland harvested; 580 acres, crop-failure land; 7,736 acres, idle or fallow cropland; 26,864 acres, plowable pasture; 82,561 acres, other land pastured; 41,936 acres, wood-

land; and 29,231 acres, all other land. The largest areas of woodland are on the steeper slopes of the uplands, with only small areas on the terraces and broader flood plains.

The farms range in size from less than 3 to 999 acres, with 1,260 farms containing less than 70 acres. There are 1,400 farms containing 70 to 179 acres; 319, from 180 to 379 acres; and 28, from 380 to 999 acres.

Selected farm data from the United States census for the years 1920 to 1945 are given in table 4.

TABLE 4.—*Statistics on farm land in Tuscarawas County, Ohio, in stated years*

Year	County area	Farms	Land—		Improved land—	
			In farms	Per farm	In farms	Per farm
	Acres	*Number*	*Percent*	*Acres*	*Percent*	*Acres*
1920	355, 200	3, 264	88. 0	95. 8	79. 3	75. 9
1930	355, 200	2, 728	77. 6	101. 1	65. 0	65. 7
1940	[1] 365, 440	2, 832	76. 4	98. 6	64. 8	63. 9
1945	365, 440	3, 007	78. 1	94. 9	46. 1	43. 8

[1] Remeasurement of county accounts for increased area.

A large part of the farming operations, especially plowing and preparation of seedbeds, is accomplished with power machinery on those farms having tractors. In 1944, 1,028 tractors were reported on 945 farms. In the same year there were 598 motortrucks on 548 farms and 2,644 automobiles on 2,270 farms.

Labor presents a serious problem to many farmers, and its availability tends to influence the extent of some farm operations. Wage and other inducements presented in local and adjacent industrial centers attract labor from the farms. Farm labor is practically all white and native to the county. Many farmers exchange labor, especially during grain harvest.

FARM TENURE

In 1944, 2,659 farms in the county were operated by owners and part owners, 339 by tenants, and only 9 by managers. Of the tenant farms, 171 were rented on a cash basis; 135, on a share-tenant and cropper basis; 6, on a share-cash basis; and 27, on other bases. When the land is rented for cash, the price per acre varies with the productivity of the soil, farm improvements and facilities, and current economic conditions. On the share basis, the tenant usually receives from one-third to one-half of the total crop produced, and some provision is made for his living privileges. The arrangement with the tenant varies, however, depending upon individual agreements.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soil scientist walks over the area at

intervals not more than one-quarter mile apart and bores into the soil with an auger or digs holes with a spade. Each boring or hole shows the soil to consist of several distinctly different layers, called horizons, which collectively are known as the soil profile. Each of these layers is studied carefully for the physical and chemical characteristics that affect plant growth.

The color of each layer is noted. The darkness of the topmost layer is usually related to its content of organic matter; streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay in each layer, is determined by the feel and is checked by mechanical analyses in the laboratory. Texture has much to do with the quantity of moisture the soil will hold available to plants, whether plant nutrients or fertilizers will be held by the soil in forms available to plants or will be leached out, and how difficult the soil may be to cultivate. Structure, or the way the soil granulates, and the number of pores or open spaces between particles indicate how easily plant roots penetrate the soil and how easily water enters it. Consistence, or the tendency of the soil to crumble or stick together, indicates how difficult it is to keep the soil open and porous under cultivation. The kind of rock from which the soil has been developed, or its parent material, affects the quantity and kind of plant nutrients the soil may contain. Simple chemical tests show how acid the soil may be.[4] The depth to bedrock or to compact layers is determined. The quantity of gravel or rocks that may interfere with cultivation, the steepness and kind of slope, the quantity of soil lost by erosion, and other external features are observed.

On the basis of these characteristics, soil areas much alike in kind, thickness, and arrangement of layers are mapped as one soil type. A phase is a subdivision of the type. Some soil types possess a narrow range of characteristics and, hence, are not divided into phases; others, with a wide range of characteristics, are mapped in two or more phases. For example, if a soil type has slopes that range from 2 to more than 30 percent, the type may be mapped in four phases—a gently sloping phase (2- to 5-percent slopes), a sloping phase (5 to 18), a steep phase (18 to 30), and a very steep phase (more than 30). A soil that has been eroded in places may be mapped in two or more phases—an uneroded phase, an eroded phase, and perhaps a severely eroded phase. A soil type will be broken into phases primarily because of differences in the soil other than those of kind, thickness, and arrangement of layers. The slope of a soil, the extent of erosion, and the relative elevation, as it affects the frequency of overflow, are characteristics that might cause a soil type to be divided into phases.

Two or more soil types may have similar profiles; that is, the soil layers may be nearly the same except that the texture, especially of the surface layer, will differ. As long as the other characteristics of the soil layers are similar, these soils are considered to belong in the

[4] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the chemical reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

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same series. A soil series, therefore, consists of all the soil types that are, except for texture, particularly of the surface layer, about the same in kind, thickness, and arrangement of layers, whether the number of such soil types be one or several.

The name of a place near where a soil series was first found is chosen as the name of the series. Thus, Muskingum is the name of a well-drained soil series developed on interbedded sandstone, siltstone, and shale in Tuscarawas County. The name of the surface texture is added to the series name to give the type name. Muskingum fine sandy loam, Muskingum silt loam, Muskingum stony fine sandy loam, and Muskingum stony silt loam are names of types within the Muskingum series. They differ in the texture of the surface soils, as their names show.

Muskingum fine sandy loam is divided into seven phases because some of this type is very gently sloping, some is sloping, some is steep, and some is very steep. Some of the sloping, steep, and very steep areas are uneroded and severely eroded. The phase units are Muskingum fine sandy loam (the normal or sloping phase); Muskingum fine sandy loam, eroded phase; Muskingum fine sandy loam, very gently sloping phase; Muskingum fine sandy loam, steep phase; Muskingum fine sandy loam, eroded steep phase; Muskingum fine sandy loam, very steep phase; and Muskingum fine sandy loam, eroded very steep phase. The dominant slopes of the very gently sloping phase fall more than 2 but less than 5 feet in 100 feet of distance; those of the sloping phases fall more than 5 but less than 18 feet in 100 feet of distance; those of the steep phases fall more than 18 but less than 30 feet in 100 feet of distance; and those of the very steep phases fall more than 30 feet in 100 feet of distance.

When two or more kinds of soil are so intricately mixed that they cannot be shown separately on the map of the scale used, they are mapped together and the areas of the mixture are called a soil complex. Muskingum-Brooke complex (formerly Westmoreland silty clay loam), Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam), and Keene-Rarden-Eifort silty clay loams, eroded steep phases, are examples of complexes in Tuscarawas County.

Areas of severely gullied or rough lands, seepy land, or riverwash that have little or no true soil material are not designated with series and type names but are given descriptive names, such as Gullied land (Muskingum soil material), Seepy land (Muskingum and Keene soil materials), and Riverwash.

The soil type, or where the type is subdivided, the soil phase, is the unit of mapping in soil surveys. It is the unit or the kind of soil that is more nearly uniform and has the narrowest range of characteristics. For this reason land use and soil management practices can be more definitely specified for it than for broader groups of soils that contain more variation. One can say, for example, that soils of the Chenango series are strongly acid in the upper part of the profile and need lime for clover. More specifically it can be said that Chenango fine sandy loam is nearly level and is used largely for cereal and hay crops, whereas Chenango gravelly loam, eroded steep phase, occurs on slopes greater than 18 percent and is considered of little value for cultivated crops, being best suited to forest. Both are in the Chenango series.

Table 5.—*Key to the soils of Tuscarawas County, Ohio* [1]

Soil characteristics	Soils of the uplands and terraces					
	Gray-Brown Podzolic soils				Planosols	
	Drainage profile No. VI [2]	Drainage profile No. V	Drainage profile No. IV	Drainage profile No. III	Drainage profile No. II	Drainage pro IV [3]
Drainage	Excessive	Somewhat excessive	Good	Moderately good	Imperfect	Good
Relief	Steep	Nearly level to sloping	Undulating to steep	Nearly level to steep	Nearly level to sloping	Nearly level
Color:						
Surface soil	Light grayish brown, yellowish brown, or light brownish yellow.	Grayish or yellowish brown.	Grayish brown, yellowish brown, or brown.	Grayish brown, yellowish brown, or yellowish gray.	Light gray, brownish gray, or grayish brown.	Grayish brow lowish bro brown.
Subsurface soil	Light brownish yellow or yellowish brown.	Yellowish or pale reddish brown.	Yellowish brown, brown, or brownish yellow.	Brownish yellow, yellowish brown, or pale yellow.	Gray, brownish gray, or mottled gray, yellow, and brown.	Yellowish brown, or b yellow.
Subsoil	Brownish yellow with some streaks of reddish brown and gray.	Yellowish brown, brownish yellow, or pale reddish brown.	Brownish yellow or yellowish brown.	Brownish or grayish yellow, mottled with gray, yellow, and brown in lower part.	Mottled gray and yellow.	Brownish ye yellowish br
Lower subsoil		Grayish yellow or pale yellow.	Brownish yellow, yellowish brown, or pale yellow.	Mottled gray, yellow, and brown.	Mottled gray and yellow, or gray.	Brownish yell lowish bro pale yellow.
Parent material from—						
Stratified noncalcareous sandstone, siltstone, and shale.	Muskingum		Wellston	Tilsit		
Noncalcareous clay shale				Keene		
Interbedded noncalcareous siltstone, sandstone, shale, and limestone.	Muskingum-Brooke complex (formerly Westmoreland).					
Interbedded noncalcareous sand-sand, siltstone, gray shale, calcareous red clay shale, and calcareous shale and limestone.	Muskingum-Upshur-Brooke complex (formerly Belmont).					
Interbedded calcareous red clay shale and noncalcareous sandstone, siltstone, and shale.	Upshur-Muskingum complex (formerly Meigs).					
Noncalcareous fire clay					Elfort	
Noncalcareous olive-drab, pale-green, or pale-red clay shale.	Rarden					
Colluvium from soils derived from sandstone, siltstone, and shale.				Tuscarawas		
Colluvium from soils derived from sandstone, siltstone, and shale; deposited over slack-water silt.				Zaleski		
Glacial till composed almost entirely of sandstone and shale material.			Wooster	Canfield		
Shallow deposits of glacial till composed almost entirely of sandstone and shale material over clay shale.				Hornell		
Stratified noncalcareous to slightly calcareous outwash gravel and sand.		Chenango				
Stratified noncalcareous to slightly calcareous old alluvium of sand, silt, and some gravel.		Conotton				
Noncalcareous slack-water deposits of silt and clay, with some sand and gravel.			Holston	Monongahela	Tyler	
Medium to strongly acid alluvium washed from soils derived from sandstone, siltstone, and shale.						Pope
Slightly acid alluvium washed largely from soils derived from glacial drift.						Chagrin
Light-colored slightly acid alluvium washed largely from soils derived from glacial drift and deposited over dark slack-water silt and clay.						

[1] Adapted (with minor change) from Key to the Soils of Ohio, unpublished manuscript by Guy W. Conrey, Ohio Agricultural Experiment Station.

[2] Profile numbers according to Ohio system of profile designation; soil colors in profile descriptions are generalized and, in some instances, do not correspond directly with those given for the same soils elsewhere in the report.

[3] Although in color and drainage characte Brown Podzolic soils of the uplands and terra

[4] Although in color and drainage characte Brown Podzolic soils of the uplands and terra

SOILS

The soils of the county range widely in color, natural drainage, fertility, slope, consistence, stoniness, and susceptibility to erosion. These are all significant in determining soil productivity, and one or more of them usually limit agricultural use of the various types and phases mapped. Soil types having different combinations of characteristics are often closely associated. Fields usually include a number of soil types, and this makes difficult the use of a single system of crop rotation, fertilization, or other plan of improvement for an individual soil.

In surface texture the soils range from fine sandy loam to silty clay loam. Surface soil color varies from light brownish gray or gray in the poorly drained to grayish brown or yellowish brown in the well-drained soils. Practically all the soils are light colored, and, except in a few depressional areas on the terraces and flood plains, the organic content of the surface soil is relatively low. The texture of the subsurface soil and subsoil ranges from fine sand to clay, and the color from gray or mottled gray, yellow, and rust brown to reddish brown. For most of the soils the reaction of the surface and subsoil layers is medium to strongly acid.

Natural drainage ranges from very poor to excessive. Water erosion is potentially severe on soils having sloping to steep relief. Accelerated erosion is severe where clean-cultivated crops are grown extensively on sloping areas without much attention to erosion control.

A key to the soil series of Tuscarawas County is presented in table 5. The great soil groups are listed in this key according to the classification of soils given in the 1938 Yearbook of Agriculture.[5] The Roman numerals are based on the Ohio system of profile designation, which is a modification of the Indiana system. The soils listed under a given Roman numeral, or drainage profile, have similar natural drainage. Differences in profile characteristics within this county are due almost entirely to the kinds of parent material on which the soils developed. For example, the Muskingum-Brooke and the Muskingum-Upshur-Brooke complexes (formerly Westmoreland silty clay loam and Belmont silty clay loam, respectively) are developed on interbedded bedrock formations that have contrasting characteristics.

Soil series listed on a horizontal line in the key are developed on similar parent material under similar climatic conditions, and differences among them in profile development are largely dependent on the kind of natural drainage existing during their development. Such a grouping of soil series is called a soil catena by soil scientists in this county. The term "catena" was first used by Milne,[6] but his definition differs from that used here.

To illustrate the catenary method of grouping used in table 5, members of the Holston, Monongahela, and Tyler series, for example, comprise a catena of soils developed on noncalcareous slack-water deposits of silt and clay, with some sand and gravel. Differences in their profile characteristics are due largely to differences in drainage con-

[5] BALDWIN, M., KELLOGG, C. E., and THORP, J. SOIL CLASSIFICATION. U. S. Dept. Agr. Yearbook (Soils and Men): 979–1001. 1938.

[6] MILNE, G. PROVISIONAL SOIL MAP OF EAST AFRICA. 34 pp., illus. 1936.

ditions and relief. The concept of the catena is useful and convenient for field identification and mapping of the soils and in considering their geographical and geological relations.

Soils of the county are placed in three main divisions: (1) Soils of uplands, (2) soils of terraces, and (3) soils of flood plains.

SOILS OF UPLANDS

The soils of the uplands are divided into (1) soils developed on bedrock formations and (2) soils developed on glacial till.

SOILS DEVELOPED ON BEDROCK FORMATIONS

The soils of the uplands developed on bedrock formations are the Muskingum, Wellston, Tilsit, Keene, Eifort, Rarden, Upshur-Muskingum complex (formerly Meigs silty clay loam), Muskingum-Brooke complex (formerly Westmoreland silty clay loam), Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam), Tuscarawas, and Zaleski. These soils developed on a variety of contrasting bedrock material. In many instances this material occurs as relatively thin interbedded layers, which are occasionally so thin and intermingled that it is impracticable to separate the soils developed on the various formations. Where separation is not possible complexes are mapped.

Muskingum, Wellston, and Tilsit Series

The Muskingum, Wellston, and Tilsit soils developed on interbedded sandstone, siltstone, and shale. The Muskingum soils occur on gently sloping to steep relief, where geologic erosion has prevented normal profile formation or development. Surface drainage is rapid; depth to bedrock is shallow, averaging about 18 to 24 inches; erosion is potentially severe because of sloping and steep relief; and in considerable part the cleared areas are moderately to severely eroded.

Wellston soils occupy ridge tops and more mildly sloping areas. Surface drainage is good to somewhat excessive; internal drainage is good. These soils have grayish-brown surface soil and yellowish-brown to brownish-yellow subsoil. The depth to bedrock ranges from 30 to 36 inches.

The Tilsit soil occupies the inner slopes of the broader ridges, where erosion is not a problem. Surface drainage is fair to good; internal drainage is restricted in the lower subsoil. The depth to bedrock ranges from 30 to 60 inches and averages about 45 inches.

Keene Series

Keene soils are developed on yellowish-gray noncalcareous clay shale. They occur most extensively in the northwestern part of the county and are usually associated with Muskingum and Wellston soils. Surface drainage is fair to excessive, depending upon the relief; internal drainage is restricted. The light brownish-gray surface soil is underlain by pale-yellow heavy silty clay loam that grades into mottled yellow, gray, and rust-brown clay at an average depth of 20 inches. Noncalcareous clay shale bedrock occurs at depths of about 30 to 40 inches.

EIFORT SERIES

Eifort soils are developed on gray noncalcareous fire clay, which usually outcrops in relatively thin (1 to 4 feet) layers, interbedded with clay shale and sandstone. Because the layers of clay are thin, areas of these soils extensive enough to map occur only on the smoother ridges. Surface drainage is good, and internal drainage is imperfect because the subsoil is heavy and impervious. Erosion is potentially severe. The light brownish-gray surface soil is underlain by mottled yellow and gray plastic clay subsoil. Bedrock of noncalcareous fire clay occurs at 14 to 20 inches.

RARDEN SERIES

Rarden soils are developed on olive-drab, pale-green, or pale-red clay shale. The relatively small areas, closely associated with Muskingum soils, occur on ridge tops and gently sloping areas in the uplands. The surface soil is grayish brown to yellowish brown; the subsoil is yellowish brown, mottled and blotched with reddish brown. Clay shale bedrock occurs at depths of 18 to 30 inches.

UPSHUR-MUSKINGUM COMPLEX

The Upshur-Muskingum complex (formerly Meigs silty clay loam) occurs in areas where the bedrock is a combination of thinly interbedded noncalcareous sandstone, siltstone, shale, and clay shale with greenish or reddish soft calcareous clay shale. The individual layers or formations vary in thickness, and corresponding to variations in the bedrock, the profile varies within short horizontal distances.

MUSKINGUM-BROOKE COMPLEX

The Muskingum-Brooke complex (formerly Westmoreland silty clay loam) is mapped on upland areas where the bedrock consists of interbedded layers of sandstone, siltstone, shale, and limestone. It represents a complex of Muskingum soils and Brooke soils. The Brooke soils are developed on limestone. The complex is on sloping to steep relief. Washing and creeping of material down the slopes has resulted in complex mixing. Surface drainage is good to excessive; internal drainage is variable, depending upon the bedrock formation.

MUSKINGUM-UPSHUR-BROOKE COMPLEX

The Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam) is mapped where bedrock of interbedded sandstone, noncalcareous and calcareous shale, red clay shale, and limestone occur in layers so thin that it is impractical to separate the soils developed on the various formations. This complex occurs on gently sloping to steep relief. Surface drainage is good to excessive, and internal drainage varies from good to restricted.

TUSCARAWAS SERIES

The moderately well drained Tuscarawas soils are developed on colluvial material that has washed and crept down the slopes of Muskingum soils and accumulated at or near the base of slopes.

Zaleski Series

The Zaleski soil occurs on slack-water terraces and represents a thin accumulation of colluvial material from slopes of Muskingum soils.

SOILS DEVELOPED ON GLACIAL TILL

The upland soils developed on glacial till composed chiefly of sandstone and shale material are the Wooster, Canfield, and Hornell. These soils occur close to the southernmost limit of advance for the Wisconsin ice sheet, which once covered extensive areas in counties to the north and northwest.

Wooster Series

The well-drained Wooster soils occupy nearly level to sloping relief. Erosion is potentially severe on the more sloping areas. Wooster soils have grayish-brown surface soil and light-brown to brownish-yellow subsoil. Gray and yellow glacial till, predominantly of sandstone, occurs at about 36 inches.

Canfield Series

The Canfield soil is moderately well drained and occurs on nearly level to gently sloping relief. Surface drainage is fair to good, but internal drainage is restricted in the lower subsoil. The surface soil is grayish brown to brownish gray; the subsoil is brownish yellow or grayish yellow, gradually changing at depths of about 18 to 22 inches to mottled gray, yellow, and brown. Glacial till, predominantly of sandstone material, occurs at depths of 24 to 36 inches.

Hornell Series

The Hornell soil is moderately well drained to imperfectly drained and occurs on nearly level to gently sloping relief. It is developed on shallow glacial till consisting in large part of shale material. The till overlies clay shale. The subsoil is heavier textured than that of the Canfield soil. Heavy noncalcareous clay shale is at depths of 30 to 60 inches.

SOILS OF TERRACES

The soils of the terraces are divided into (1) soils developed on outwash gravel and sand and (2) soils developed on slack-water deposits of silt and clay, with some sand and gravel.

SOILS DEVELOPED ON OUTWASH GRAVEL AND SAND

The terrace soils developed on outwash gravel and sand are the Chenango and Conotton. The material, largely rounded sandstone and shale gravelstones with a small proportion of igneous rocks and a smaller proportion of limestone mixed in, was deposited by streams flowing from the glacier to the north. These terraces are extensive in the valleys of the Tuscarawas River and Sugar Creek but less extensive in the valleys of smaller tributary streams.

Chenango Series

The well-drained to excessively drained Chenango soils occupy the higher lying terraces, which frequently occur on several successive

levels. Generally the relief is nearly level, but a relatively small acreage occurs on sloping relief. The surface soil is grayish brown to yellowish brown, and the subsoil is yellowish brown to brownish yellow. In general, the texture of the subsoil varies with the texture of the surface soil. The heavier textured Chenango soils are somewhat compact, plastic, and gravelly. Loose gravel and sand occur at depths varying from 18 to 60 inches.

Conotton Soils

Conotton soils are well drained and occupy lower lying terraces. Usually they have a position intermediate between areas of alluvial soils and Chenango soils. The relief is nearly level, and drainage is largely internal.

SOILS DEVELOPED ON SLACK-WATER DEPOSITS OF SILT AND CLAY, WITH SOME SAND AND GRAVEL

Soils of the terraces developed on slack-water deposits of silt and clay, with some sand and gravel, are the Holston, Monongahela, and Tyler. The terraces consist of material deposited by north-flowing streams that were blocked by the advance of the ice sheet from the north and by the waters that flowed from the ice sheet. The current was retarded, the streams were eventually ponded, and finally lakes were formed. Silt and clay were deposited several feet deep in the relatively quiet lakes. The present streams have cut into these deposits and formed relatively narrow flood plains. The lake deposits left bordering the narrow flood plains remain as terraces, occasionally on two or more successive levels. The soils developed on these slack-water deposits are most extensive in the valleys of Stillwater Creek and the Tuscarawas River and occur to lesser extent in valleys of the smaller streams south of the Tuscarawas River.

Holston Series

The well-drained Holston soils occupy nearly level to sloping relief. Drainage is largely internal on nearly level areas, but surface drainage is good to excessive on sloping areas. The surface soil is yellowish brown to grayish brown. The subsoil is brownish yellow to yellow. Yellow and gray stratified silt, sand, clay, and gravel occur at 28 to 40 inches.

Monongahela Series

Monongahela soils are moderately well drained and occupy nearly level to undulating relief. They have light grayish-brown to brownish-gray surface soils. The pale-yellow subsoil grades into mottled gray, yellow, and brown below a depth of 18 to 24 inches. The mottled gray, yellow, and brown underlying stratified silt and clay, with some sand admixed, lies at depths of 30 to 40 inches.

Tyler Series

The imperfectly drained Tyler soils occur on nearly level relief. Surface drainage is slow; internal drainage, imperfect. Tyler soils have gray to light brownish-gray surface soil and mottled gray, yellow, and brown subsoil. The underlying material is mottled gray and yellow stratified clay and silt in which occur thin layers of sand.

SOILS OF FLOOD PLAINS

The soils of the flood plains are divided into two groups: (1) Medium to strongly acid soils and (2) slightly acid soils.

MEDIUM TO STRONGLY ACID SOILS OF FLOOD PLAINS

The medium to strongly acid soils of the flood plains are the Pope, Philo, Atkins, Elkins, and Killbuck. They are all subject to flooding, and any area may receive deposits from one or more floods each year. Their material has been washed and is washing from areas of Muskingum, Keene, Wellston, and other upland soils as well as from soils of the slack-water deposits. The alluvium is more or less stratified, and the soils have not developed a profile because new material is added during floods. Any area may, in the course of a single flood, be changed to a different texture by deposits of lighter or heavier textured materials.

Pope Series

The well-drained Pope soils have grayish-brown to brownish gray surface soil and yellowish brown subsoil. They are underlain by mottled gray, brown, and yellow somewhat stratified silt, clay, sand, and gravel.

Philo Series

The moderately well drained Philo soils have grayish-brown to brownish-yellow surface soil and pale-yellow subsoil that is mottled gray and yellow at depths of 16 to 24 inches. Philo soils consist of gray and yellow somewhat stratified silt, clay, and sand.

Atkins Series

Atkins soils are imperfectly to poorly drained and occupy the slightly depressional areas or old stream channels within the broader flood plains. They have light-gray to brownish-gray surface soil and mottled gray, yellow, and brown subsoil. Underlying is mottled gray, yellow, and brown stratified clay, silt, and sand.

Elkins Series

The poorly drained Elkins soil usually occupies depressional areas. The surface soil, dark brownish gray to dark gray, is underlain by mottled gray, yellow, and brown silt and clay.

Killbuck Series

The Killbuck soil has fair drainage of the surface layer but poor underdrainage. It consists of relatively shallow water-laid deposits of light-colored material on dark alluvium.

SLIGHTLY ACID SOILS OF FLOOD PLAINS

The slightly acid soils of the flood plains are the Chagrin, Lobdell, and Wayland. They occupy flood plains of rivers and streams that receive part of their material from glaciated areas. They occur principally in the valley of the Tuscarawas River and those tributaries that flow through or drain areas of soils underlain by glacial till.

CHAGRIN SERIES

Chagrin soils are well drained and have brown surface soil and yellowish-brown subsoil. They are underlain by brownish-yellow stratified layers of silt, clay, and to some extent, sand.

LOBDELL SERIES

The moderately well drained Lobdell soils are associated with Chagrin soils but usually occupy positions somewhat removed from the stream channels. They have grayish-brown to pale-yellow surface soil. The brownish-yellow to pale-yellow subsoil is mottled gray, yellow, and brown at depths of 16 to 24 inches. The underlying material is similar to that under the Chagrin soils.

WAYLAND SERIES

The poorly drained Wayland soil usually occurs in old abandoned stream channels well back from present streams. The surface soil is gray with streaks of yellow; the subsoil is mottled gray, yellow, and brown. The mottled underlying material—either silt or clay, with some sand—shows evidence of depositional layers.

SOIL TYPES AND PHASES

In the following pages the soils, identified by the same symbols as those on the soil map, are described in detail and their agricultural relations are discussed. Their location and distribution are shown on the map in the envelope on page 3 of the cover, and their approximate acreage and proportionate extent are given in table 6.

TABLE 6.—*Approximate acreage and proportionate extent of the soils mapped in Tuscarawas County, Ohio*

Soil	Acres	Percent
Atkins fine sandy loam	46	(1)
Atkins silt loam	12, 246	3. 4
High-bottom phase	730	. 2
Atkins silty clay loam	1, 858	. 5
Canfield silt loam	116	(1)
Chagrin fine sandy loam	821	. 2
Chagrin loam	2, 935	. 8
High-bottom phase	555	. 2
Chagrin silt loam	3, 223	. 9
High-bottom phase	2, 231	. 6
Chenango fine sandy loam	1, 174	. 3
Eroded gently sloping phase	153	(1)
Gently sloping phase	88	(1)
Chenango gravelly loam	393	. 1
Eroded steep phase	1, 263	. 4
Gently sloping phase	513	. 1
Chenango loam	3, 865	1. 1
Eroded gently sloping phase	114	(1)
Gently sloping phase	107	(1)
Chenango loamy fine sand	244	. 1
Eroded gently sloping phase	184	. 1

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils mapped in Tuscarawas County, Ohio*—Continued

Soil	Acres	Percent
Chenango silt loam	9, 052	2. 5
Deep phase	625	. 2
Eroded gently sloping phase	159	(1)
Gently sloping phase	337	. 1
Silted phase	254	. 1
Conotton fine sandy loam	333	. 1
Conotton gravelly silt loam	69	(1)
Conotton loam	864	. 3
Eroded gently sloping phase	48	(1)
Conotton silt loam	862	. 2
Silted phase	120	(1)
Eifort silty clay loam	75	(1)
Eroded phase	174	(1)
Elkins silty clay	176	(1)
Gullied land:		
Eifort and Rarden soil materials	32	(1)
Muskingum soil material	44	(1)
Holston fine sandy loam	507	. 1
Holston silt loam, eroded steep phase	829	. 2
Hornell silt loam	240	. 1
Keene-Rarden-Eifort silty clay loams, eroded steep phases	124	(1)
Keene silt loam	3, 369	. 9
Eroded phase	21, 531	6. 0
Eroded steep phase	2, 215	. 6
Eroded very gently sloping phase	292	. 1
Severely eroded phase	87	(1)
Severely eroded steep phase	100	(1)
Very gently sloping phase	2, 874	. 8
Killbuck silt loam	66	(1)
Lobdell silt loam	1, 003	. 3
High-bottom phase	87	(1)
Made land, mine pits, and dumps	4, 131	1. 2
Monongahela silt loam	11, 962	3. 3
Eroded light-textured subsoil phase	265	. 1
Eroded phase	214	. 1
Eroded undulating phase	1, 295	. 4
Light-textured subsoil phase	3, 137	. 9
Undulating phase	2, 057	. 6
Muskingum-Brooke complex (formerly Westmoreland silty clay loam)	538	. 2
Muskingum-Brooke complex, eroded phases (formerly Westmoreland silty clay loam, eroded phase)	1, 143	. 3
Muskingum-Brooke complex, eroded steep phases (formerly Westmoreland silty clay loam, eroded steep phase)	177	(1)
Muskingum fine sandy loam	750	. 2
Eroded phase	2, 464	. 7
Eroded steep phase	4, 269	1. 2
Eroded very steep phase	3, 560	1. 0
Steep phase	298	. 1
Very gently sloping phase	197	. 1
Very steep phase	453	. 1
Muskingum silt loam	29, 372	8. 1
Colluvial phase	970	. 3
Eroded phase	31, 199	8. 6
Eroded steep phase	72, 688	20. 1
Eroded very steep phase	26, 141	7. 2
Severely eroded phase	294	. 1
Severely eroded steep phase	782	. 2

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils mapped in Tuscarawas County, Ohio*—Continued

Soil	Acres	Percent
Muskingum silt loam—Continued		
Severely eroded very steep phase	335	0.1
Steep phase	14,006	3.9
Very gently sloping colluvial phase	67	(1)
Very steep phase	5,404	1.5
Muskingum stony fine sandy loam	127	(1)
Eroded steep phase	384	.1
Muskingum stony silt loam	7,900	2.2
Eroded phase	2,237	.6
Eroded very steep phase	2,294	.7
Very gently sloping phase	53	(1)
Very steep phase	2,536	.7
Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam)	86	(1)
Muskingum-Upshur-Brooke complex, eroded phases (formerly Belmont silty clay loam, eroded phase)	282	.1
Muskingum-Upshur-Brooke complex, eroded steep phases (formerly Belmont silty clay loam, eroded steep phase)	32	(1)
Philo loam	528	.2
Philo silt loam	17,343	4.8
High-bottom phase	1,009	.3
Pope fine sandy loam	380	.1
Pope loam	830	.2
High-bottom phase	127	(1)
Pope silt loam	4,211	1.2
High-bottom phase	1,582	.4
Rarden silt loam	128	(1)
Eroded phase	855	.2
Very gently sloping phase	99	(1)
Riverwash	57	(1)
Seepy land (Muskingum and Keene soil materials)	3,098	.9
Tilsit silt loam	85	(1)
Tuscarawas silt loam	5,277	1.5
Eroded phase	190	.1
Tyler silt loam	5,675	1.6
Tyler silty clay loam	170	(1)
Upshur-Muskingum complex (formerly Meigs silty clay loam)	66	(1)
Upshur-Muskingum complex, eroded phases (formerly Meigs silty clay loam, eroded phase)	339	.1
Wayland silt loam	548	.2
Wellston silt loam	180	.1
Eroded shallow phase	505	.1
Shallow phase	3,999	1.1
Sloping phase	141	(1)
Wooster silt loam	411	.1
Gently undulating phase	147	(1)
Zaleski silt loam	754	.2
Total	362,240	100.0

[1] Less than 0.1 percent.

Atkins fine sandy loam (AA).—This inextensive soil lies at the heads of narrow drainageways and in slight depressions on the larger bottoms. It has developed on alluvium washed from sandstone, siltstone, and shale of upland and acid terrace areas. It is the poorly

drained member of the soil catena that also includes the well-drained Pope and the moderately well drained Philo soils. The natural vegetation included swamp oak, willow, ash, sycamore, soft maple, and birch.

Profile in cultivated areas:

0 to 7 inches, light-gray to light brownish-gray fine sandy loam containing many small firm yellow or brown iron concretions and a few light-yellow blotches; strongly to medium acid.

7 inches +, mottled yellow, gray, and brown fine sandy loam, fine sand, and gravel; texture not uniform; alternating layers of variable thickness occur; strongly to medium acid.

The profile varies in texture and color. A few areas have surface texture of fine sand, whereas small isolated areas closely associated with the gravelly terraces have a gravelly loam.

Use and management.—Atkins fine sandy loam is probably better for permanent pasture and forest than for cultivated crops. It is used chiefly for pasture, but a considerable acreage is in forest. Crop yields are low because drainage is poor and the surface soil and subsoil are light textured.

Atkins silt loam (AB).—Numerous areas of this soil occur at the heads of small drainageways and in the slight depressions on the larger stream bottoms well back from the stream channels. This is the poorly drained member of the soil catena that also includes the well-drained Pope and the moderately well drained to imperfectly drained Philo soils. The parent material is chiefly from residual sandstone, siltstone, and shale washed from upland areas and slack-water terraces. Natural vegetation was chiefly swamp oak, soft maple, willow, sycamore, and ash.

Profile in cultivated areas:

0 to 7 inches, light-gray to brownish-gray friable soft granular silt loam with a few yellow and brown mottlings; organic content relatively low; many small rounded firm iron concretions on the surface and through the soil; strongly to medium acid.

7 to 15 inches, mottled light-gray, yellow, and brown friable silt loam; intensity of mottling increases with depth; strongly to medium acid.

15 to 30 inches, mottled light-gray, yellow, and brown moderately compact heavy silt loam to silty clay; thin depositional layers of contrasting textures noticeable; strongly to medium acid.

30 inches +, mottled gray, yellow, and brown stratified silt, clay, and sand; thickness of the variously textured materials varies within short horizontal distances; strongly to medium acid.

The profile varies in texture and color. A few included areas have a brownish-gray surface soil to a depth of 6 to 9 inches, and under this, mottled gray, yellow, and brown material.

Use and management.—Practically all of Atkins silt loam has been cleared of timber, and a large part has been cultivated. About 40 percent is now in permanent pasture, and about 15 percent is idle land supporting a growth of briers, weeds, and small trees. The rest of the land is cultivated.

The cultivated areas are cropped chiefly to corn and hay, but occasionally to oats. Under present management corn is usually fertilized. It yields 15 to 36 bushels an acre. The higher yields are obtained where artificial drainage has been installed and enough lime and commercial fertilizer are used. In years of normal moisture, this soil is usually somewhat too wet for the successful growth of oats,

but in periods of diminished rainfall it may produce good crops. Oat yields under present practices range from 18 to 30 bushels an acre. Hay crops are usually a mixture of timothy and alsike. The soil is not well adapted to alfalfa and clover; it has too high a moisture content and is acid. From 2 to 4 tons of ground limestone an acre must be applied before legumes can be grown. Fair to good crops of soybeans have been obtained recently by installing artificial drainage and applying sufficient lime.

The chief management practices for this soil are improvement of drainage, application of lime to correct acidity, and incorporation of organic matter. Long narrow areas, often cut off from the surrounding upland by numerous small streams or drainageways, are best used for permanent pasture.

Atkins silt loam, high-bottom phase (Ac).—This phase is similar to Atkins silt loam but occurs slightly higher on the flood plain and is therefore easier to drain. Natural drainage is often poor because of seepage from the adjacent upland. Nevertheless, the danger of crop loss from overflow or ponding is less than for Atkins silt loam. About the same crops are grown as on Atkins silt loam but yields are slightly higher on this phase.

Atkins silty clay loam (Ad).—This soil developed on alluvium from upland areas of sandstone, siltstone, and shale and from terraces of slack-water clay and silt. It is the poorly drained member of the soil catena that includes the well-drained Pope and the moderately well drained to imperfectly drained Philo soils. Areas are usually in slight depressions back from the streams and in abandoned stream channels. Surface and internal drainage are poor; water often remains above or near the surface a considerable time after it has disappeared from better drained soils. The natural vegetation includes swamp oak, sycamore, willow, and other water-tolerant trees.

Profile in cultivated areas:

0 to 7 inches, light-gray to light brownish-gray silty clay loam showing a few brown stains or blotches and containing many small rounded firm iron concretions; organic content relatively low; strongly to medium acid.

7 inches +, mottled light-gray, yellow, and brown silty clay loam to heavy compact slowly pervious clay; strongly to medium acid.

Variations in the profile characteristics are in color and texture. Some areas have a darker surface soil somewhat higher in organic content. Relatively thin lenses or layers of very fine sand and silt occur in the lower subsoil in some places. In the eastern part of the county, along Stillwater Creek, lies an inclusion with a dark-gray silty clay surface soil to a depth of 10 to 12 inches, under which occurs mottled gray, yellow, and brown plastic clay.

Use and management.—Most of Atkins silty clay loam has been cleared of timber and cultivated. About two-thirds of the cleared land is now in permanent pasture and one-third in cultivated crops, including corn, oats, soybeans, and hay. Crop yields are extremely variable, for they depend largely upon the adequacy of artificial drainage and favorability of the season. Under present management practices corn yields 15 to 40 bushels an acre. The higher yields are obtained during seasons having favorable moisture. Oats are not well adapted and are grown in only small quantity. Oats yield 15 to 30

bushels an acre under present management. Excessive moisture after planting seriously damages the oat crop, and low yields or crop failures are common.

Soybeans are grown to a limited extent, and, where artificial drainage is adequate, yield 10 to 15 bushels an acre. For successful growth of legumes artificial drainage should be installed and sufficient lime applied to correct soil acidity. Hay crops consist chiefly of a mixture of timothy and alsike clover. With favorable conditions yields are ¼ to 1 ton an acre under present management practices. The soil is not well adapted to wheat. There is danger that the crop will be drowned out or damaged by heaving of the soil in winter and early in spring. A few farmers attempt to grow red clover and alfalfa, both of which are not well suited to soil with such a high moisture content. Fair to good permanent pasture can be obtained by installing adequate drainage and applying enough lime.

Canfield silt loam (C).—This soil has developed on Wisconsin glacial till composed chiefly of sandstone material but containing small quantities of shale material. It is the moderately well drained member of the soil catena that also includes the well-drained Wooster. It is mapped in the extreme northwestern part of the county in association with Wooster and Hornell soils. The relief is nearly level to gently sloping. Slopes do not exceed 5 percent. The natural vegetation consisted chiefly of oak, hickory, maple, and associated species.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to brownish-gray friable gritty silt loam; contains a small quantity of organic matter; a few small shale and sandstone fragments occur on the surface and throughout the layer; medium to strongly acid.

7 to 18 inches, brownish-yellow or grayish-yellow gritty slightly compact heavy silt loam with a few gray mottlings in the lower part; medium to strongly acid.

18 to 30 inches, mottled gray, yellow, and brown gritty heavy silt loam containing many small sandstone fragments; friable when moist but somewhat compact when dry; medium to strongly acid.

30 inches +, mottled gray, yellow, and brown silt loam to loam containing many sandstone fragments; medium acid.

The profile varies in color and texture, except the surface texture. Included are a few areas with a dark-gray friable silt loam surface soil to a depth of 6 to 7 inches, and underlying, a gray or brownish-gray silt loam blotched and stained with yellow. Drainage for this included area is poorer.

Use and management.—Crop rotations on Canfield silt loam include corn, oats or wheat, and hay, all grown in support of dairying. From 150 to 250 pounds of commercial fertilizer is commonly used for corn. Yields range from 32 to 54 bushels an acre. Wheat yields 22 to 30 bushels; oats, from 38 to 45. From 150 to 250 pounds of commercial fertilizer an acre is used with wheat, but oats receive very little. The hay crops include timothy, alsike, and red clover, grown alone or in mixture. From 2 to 4 tons of lime an acre should be applied to correct acidity and assure successful growth of legumes.

This soil is well adapted to potatoes and is extensively used for this crop elsewhere in the State. Here, however, the acreage is so limited and widely distributed in small areas that potatoes are not extensively grown. Soybeans, an increasingly important crop, yield 12 to 25 bushels an acre.

All available organic matter, either in the form of barnyard or green manure, and sufficient lime to correct acidity must be applied to this soil if productivity is to be maintained or increased. The soil is naturally low in plant nutrients, and addition of nitrogen, phosphorus, and potash in some form is a necessary part of good management.

Chagrin fine sandy loam (CA).—Streams draining the glacial upland north of the county and those flowing from residual sandstone and shale areas have areas of this soil along their courses. The soil is the well-drained member of the catena that also includes the moderately well drained Lobdell and the poorly drained Wayland soils. Areas often occur as narrow discontinuous strips along or near stream banks.

Profile in cultivated areas:

0 to 7 inches, light-brown or grayish-brown fine sandy loam; slightly acid to neutral.

7 inches +, yellowish-brown fine sandy loam to fine sand; variable texture in lower subsoil; in places includes thin layers of coarse sand and gravel; slightly acid to neutral.

The profile varies in texture of the surface soil and subsoil. A few areas with a loamy sand surface texture are included.

Use and management.—The use made of this soil is often governed by that of the adjacent alluvial soils. The crops are chiefly corn, soybeans, and hay. Corn yields 18 to 36 bushels an acre. Hay crops are fair. The land along streams is usually left in wooded pasture.

Chagrin loam (CB).—Areas of this alluvial soil have developed in some of the main valleys of the county where the streams drain from the glaciated area to the north. This is the well-drained member of the soil catena that also includes the moderately well drained Lobdell and the poorly drained Wayland soils. It occurs on nearly level areas, principally on flood plains of the Tuscarawas River. The natural vegetation included elm, ash, sycamore, and cottonwood.

Profile in cultivated areas:

0 to 9 inches, brown friable loam; slightly acid to neutral.

9 to 15 inches, light-brown loam to heavy loam with thin bands of silt loam and fine sandy loam; slightly acid to neutral.

15 inches +, yellowish-brown material of variable texture, including loam, silt loam, fine sandy loam, and sand, showing stratification; neutral in reaction.

Variations in texture and thickness of the different layers are common.

Use and management.—Most of the soil has been cleared and is used chiefly for corn and hay. Some small grain is also grown. Under present management corn yields 40 to 65 bushels; mixed hay, about 1.6 to 2.5 tons an acre. There is some crop loss from seasonal floods.

Chagrin loam, high-bottom phase (CC).—This phase occupies areas several feet above the main level of the flood plain and is subject to overflow only at extreme flood stage. It is similar to Chagrin loam except its subsoil is somewhat more compact.

Corn, wheat, soybeans, and hay are among the crops grown. Small-grain crops grown in the rotation are somewhat more successful than on Chagrin loam. Yields are comparable on the two soils, although loss from floods is less on this phase.

Chagrin silt loam (CD).—Areas of this soil occur principally adjacent to the Tuscarawas River and some of the larger streams that

derive their sediments from areas influenced by glaciation. The soil has developed on mixed alluvium, which is derived from areas influenced by wash from glacial material as well as from residual material derived from sandstone and shale. It is the well-drained member of the catena that also includes the moderately well drained Lodbell and the poorly drained Wayland soils. The natural vegetation included sycamore, ash, elm, beech, and maple.

Profile in cultivated areas:

0 to 8 inches, brown friable silt loam; variable organic content; neutral to slightly acid.

8 to 30 inches, brown to yellowish-brown friable silt loam to silty clay loam; neutral to slightly acid.

30 inches +, brownish-yellow to yellow-brown silt loam to silty clay loam with an occasional layer of sandy material; neutral in reaction.

The profile varies in texture and thickness of the various layers and in the content of organic matter in the surface layer. Included are small areas that have a silty clay loam surface texture and smaller areas with a fine sandy loam texture.

Use and management.—Chagrin silt loam is one of the most productive soils in the county for corn and is largely used for this crop. Corn yields 40 to 65 bushels an acre. In seasons when weather conditions have been extremely favorable, corn has yielded 80 bushels or more. Areas are subject to flooding late in winter and early in spring; thus, the crop rotation used is somewhat different from that practiced on soils not subject to flooding. The rotation usually includes corn and soybeans, but a few areas are planted to wheat and hay. Wheat yields 22 to 26 bushels an acre under present management, but damage from flooding is occasionally severe.

Clover and alfalfa are well adapted, and excellent yields are obtained without using lime. Flooding causes occasional severe losses. Soybeans have become important in the last few years. They yield 20 to 30 bushels or more an acre. Soybeans are not so subject to injury from flooding as fall-sown small grains and hay crops, for the floods are not so frequent in summer and early in fall as in winter and early in spring.

Chagrin silt loam, high-bottom phase (Ce).—Separation of this phase from Chagrin silt loam is made entirely on the basis of its higher position above the main flood plain. The areas lie principally in the valleys of the larger rivers and streams. In profile characteristics this phase is very similar to the silt loam, but its subsoil is somewhat more compact in places.

Corn, wheat, oats, hay, and soybeans are the principal crops. Proportionately, more small grain and hay is grown on this phase than on Chagrin silt loam, and crop losses from flooding are less.

Chenango fine sandy loam (Cf).—This well-drained to excessively drained soil is developed on gravel and sand glaciofluvial outwash terraces. The gravel is composed largely of sandstone and shale material, though minor quantities of limestone and igneous rock are included. Areas occur on nearly level terrace positions in the larger stream valleys, frequently at the outer edge of the terraces adjoining sloping areas within the terrace. The natural vegetation consisted of deciduous trees, principally oak, hickory, ash, and maple.

Profile in cultivated areas:

0 to 8 inches, grayish-brown or light yellowish-brown fine sandy loam; relatively low organic content; medium to strongly acid.

8 to 20 inches, yellowish-brown fine sandy loam or sandy loam containing enough finer textured material to be somewhat coherent when moist; medium to strongly acid.

24 to 32 inches, yellowish-brown to brown sandy loam to clay loam; slightly more compact than the layers above; medium to strongly acid.

32 inches +, gray or grayish-yellow loose stratified water-worn gravel and sand composed largely of sandstone and shale; strongly to medium acid in upper part and decreasingly acid with depth; a small quantity of limestone present in small areas at depths of 8 to 10 feet; thin incrustations of lime on the gravel in some areas.

The profile varies in color, texture (except surface texture), and depth to loose stratified gravel and sand.

Use and management.—Practically all of Chenango fine sandy loam is cleared of trees and used largely for cereal and hay crops. Because it is somewhat droughty, it is not so well adapted to corn as the heavier textured Chenango soils. During years of abnormally low moisture, crop yields are materially reduced. This soil is better adapted to wheat than to oats because moisture conditions are somewhat better in spring and in early summer during the period of wheat growth than in late summer, when oats usually make their rapid growth. Hay crops consist chiefly of a mixture of timothy, alsike, and red clover. An increasingly large acreage is used for soybeans, which yield 10 to 15 bushels an acre. Small areas, usually near the larger industrial centers, are used for potatoes, tomatoes, sweet corn, and other vegetables.

This soil is naturally deficient in organic matter and plant nutrients, and constant replenishment of these is necessary to maintain or increase productivity. The looseness of the surface and subsoil material contributes to the somewhat droughty nature and low moisture-holding capacity. Organic matter should be incorporated in the soil in quantities sufficient to increase the water-holding capacity and fertility. Crop rotations generally include corn, wheat or oats, soybeans, and hay. There is limited production of vegetable crops. Commercial fertilizer is commonly used for corn, which yields from 25 to 36 bushels an acre. The higher yields of corn are obtained under good management and favorable weather. The common practice of using 100 to 250 pounds of commercial fertilizer an acre with wheat gives yields of 13 to 25 bushels an acre. Lime must be applied to correct acidity before clover can be grown successfully.

Chenango fine sandy loam, gently sloping phase (CH).—This soil occurs dominantly on slopes of 5 to 12 percent on glaciofluvial outwash terraces. It is associated with other Chenango soils and in profile characteristics is essentially the same as Chenango fine sandy loam. Nevertheless, the various layers are somewhat thinner.

The soil is susceptible to erosion and is slightly droughty. Crop yields are somewhat below those obtained on the fine sandy loam.

Chenango fine sandy loam, eroded gently sloping phase (CG).—From 25 to 75 percent of the surface soil of this phase has been removed by erosion. The surface soil, extending to depths of 6 or 7 inches, is brownish-yellow to yellowish-brown fine sandy loam, ex-

tremely low in organic content. The rest of the profile is similar to that of the fine sandy loam.

Because the surface soil is eroded and slopes range from 5 to 12 percent, the soil is somewhat more droughty and produces materially lower crop yields than the fine sandy loam. To avoid additional loss of soil material conservation practices are advisable.

Chenango gravelly loam (CI).—This soil has developed on stratified gravel and sand composed largely of sandstone and shale material. It occurs on 2- to 5-percent slopes on the higher glaciofluvial outwash terraces of larger streams. Areas are principally on the margin of terrace and on undulating areas within the terrace. Surface drainage is good to excessive, and internal drainage is somewhat excessive because the surface soil, subsoil, and underlying material are porous. The natural vegetation was principally oak and hickory, with other species associated.

Profile in cultivated areas:

0 to 8 inches, grayish-brown to light yellowish-brown gravelly loam; extremely low organic content; content of gravel variable but usually enough to interfere with cultivation; medium to strongly acid.

8 to 15 inches, brown to yellowish-brown slightly plastic gravelly loam or gravelly sandy loam; medium to strongly acid.

15 inches +, gray to grayish-yellow stratified loose water-worn gravel and sand composed chiefly of sandstone and shale but including minor quantities of limestone and other rock materials; upper part strongly to medium acid, but layer in many places gradually becomes calcareous at depths of 8 to 10 feet or more.

Profile variations are in the texture and thickness of the various layers, the content of gravel on the surface and throughout the soil, and the depth to loose gravel and sand.

Use and management.—Nearly all of Chenango gravelly loam has been cleared of trees and cultivated, though some areas are now idle. These idle areas are covered with various weeds and briers. The soil is not so well suited to the crop rotation used on heavier textured types of Chenango soils, for it has low moisture-holding capacity and cultivation of its gravelly surface soil is difficult. The principal crops are corn, wheat, and hay. Under present management corn yields 25 to 42 bushels an acre, and wheat, 15 to 26 bushels. The soil is not well suited to corn because it has only a limited moisture supply. Yields of corn are materially reduced during periods of low moisture. Some attempts are made to grow oats, but yields are usually very low. Hay crops include mixtures of clover, alsike, and timothy, but because of droughtiness, yields are low.

Chenango gravelly loam, gently sloping phase (CK).—Although this phase has a slope up to 18 percent, most slopes are less than 10 percent. This soil is on the more gently sloping terrace escarpments. Drainage is good to somewhat excessive. Its various layers are somewhat thinner, but otherwise this phase is similar to Chenango gravelly loam in profile characteristics. Included are some areas that have been eroded and are somewhat more gravelly.

This soil is droughty and therefore of relatively low agricultural value. Nearly all areas have been cleared and cultivated but many are now idle. Corn, wheat, and hay produce fairly well, but yields are below those of Chenango gravelly loam.

Chenango gravelly loam, eroded steep phase (CJ).—Slopes greater than 18 percent on the steep areas of the outwash plains are occupied by this soil. The areas are between less sloping terrace land and the alluvial flood plains. Narrow steep bodies of this soil may be between successive terrace levels. Considerable variation exists in texture, thickness, and gravel content. More than 25 percent of the surface soil has been removed by erosion, and an occasional gully may occur. Included are a few small areas showing only slight erosion. Also included are a few severely eroded areas that have lost all the surface soil and much of the subsoil through erosion.

Except for few of the included areas having only slight erosion, most of this phase has been cleared. Some areas furnish pasture of low quality. The included severely eroded areas support only a scant vegetation of briers, weeds, and small brush, and much bare ground is exposed. The soil is best suited for forest or permanent pasture.

Chenango loam (CL).—This nearly level soil has developed on the gravel and sand of the glaciofluvial outwash terraces. The gravel is composed largely of sandstone and shale, though minor quantities of limestone and igneous rock material are included. The largest soil areas occur in the valleys of the Tuscarawas River and Sugar and Sandy Creeks. Surface drainage is slow, and internal drainage is good to slightly excessive. The natural vegetation consisted of deciduous trees, including oak, hickory, maple, ash, and elm.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable loam; relatively low organic content; medium to strongly acid.

7 to 15 inches, yellowish-brown or brownish-yellow friable heavy loam containing variable quantities of small rounded sandstone and shale gravelstones; medium to strongly acid.

15 to 30 inches, brownish-yellow gravelly and slightly plastic clay loam to sandy clay loam; medium to strongly acid.

30 inches +, grayish-yellow stratified loose gravel and sand composed largely of sandstone and shale; upper part medium to strongly acid, but reaction is neutral to slightly alkaline at depths of 8 to 10 feet.

The soil varies in texture and thickness of the various layers, the quantity of rounded gravel on the surface and in the soil, and the depth to stratified gravel and sand. The depth to the loose gravel varies from 20 to 36 inches or more.

Use and management.—Most of this soil is cleared of timber and is cultivated. Corn, wheat, soybeans, and hay, and small acreages of vegetables are among the crops grown. Under present management corn produces 30 to 48 bushels an acre, the yield depending largely upon moisture supply, state of soil productivity, and quantity of commercial fertilizer used. The soil is better adapted to wheat than oats. Wheat yields 17 to 28 bushels an acre under ordinary management. From 150 to 250 pounds of commercial fertilizer an acre is commonly used for wheat. More soybeans are grown than formerly; yields range from 10 to 20 bushels an acre. Soybeans are usually grown after corn in this rotation, or where hay crops fail. Hay crops are usually a mixture of timothy, alsike, red clover, and, in a few instances, alfalfa. Sufficient lime to correct the soil acidity must be applied before clover and alfalfa can be grown successfully.

Chenango loam, gently sloping phase (CN).—This soil occurs on 5- to 12-percent slopes in association with the other Chenango soils of the glaciofluvial outwash terraces. In physical and chemical features it is similar to Chenango loam, but it has a thinner surface layer and less depth to the underlying gravelly and sandy substrata. Owing to its slope, it is more susceptible to erosion than Chenango loam, and crop yields are somewhat less.

Chenango loam, eroded gently sloping phase (CM).—From 25 to 75 percent of the surface soil of this phase has been eroded away. Areas occur dominantly on 5- to 12-percent slopes in association with the other Chenango soils on the gaciofluvial plains. Profile characteristics are similar to those of Chenango loam, except that the surface soil, to a depth of 6 or 7 inches, is brownish-yellow to yellowish-brown heavy silt loam to clay loam very low in organic content.

Yields are considerably lower than those obtained on Chenango loam. More sloping relief makes this phase susceptible to further injury by erosion, and for this reason rotations should consist predominantly of cover crops and proper erosion control practices should be practiced.

Chenango loamy fine sand (Co).—Fine gravel and sand of the glaciofluvial outwash terraces is the material on which this well-drained soil developed. The source of the gravel and sand is largely sandstone and shale, though minor quantities of limestone and igneous material are included. The areas are on nearly level to gently undulating terraces, principally in the valleys of the larger streams. The natural vegetation consisted chiefly of oak and hickory, with some maple, ash, and elm in the stand.

Profile in cultivated areas:

0 to 8 inches, grayish-brown or grayish-yellow loose loamy fine sand; medium to strongly acid.

8 to 32 inches, yellowish-brown to yellow fine sand to sand grading gradually to pale yellow incoherent fine sand; medium to strongly acid.

32 inches +, grayish-yellow stratified sand and fine sand; coarse gravel notably absent within a depth of 6 to 8 inches.

Use and management.—Most of this soil is idle or is poor quality pasture. The few areas cropped produce low yields. With careful management the soil can be used for rotation crops, particularly certain truck crops.

Chenango loamy fine sand, eroded gently sloping phase (CP).—Areas of this soil occur dominantly on slopes of 5 to 12 percent, but slopes may range up to 18. About 25 percent of the surface has been removed by erosion.

The present surface soil is yellowish-brown loose fine sand that is low in organic matter. The subsoil and substrata are similar to those of Chenango loamy fine sand.

Because of its low agricultural value, especially its droughtiness, the most practical use of this soil is for pasture or forest. The pasture is of low carrying capacity, the vegetation consisting largely of broomsedge, poverty grass, briers, and weeds. About 10 to 15 percent of the surface is bare.

Chenango silt loam (CQ).—This soil developed on glaciofluvial outwash plains and terraces in the valleys of the larger streams and

rivers. Surface drainage is slow, and internal drainage is good to slightly excessive. The natural vegetation was chiefly oak, hickory, ash, elm, and maple.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam; relatively low organic content; variable numbers of rounded gravel on surface and in layer, but not enough to interfere with cultivation; medium to strongly acid.

7 to 15 inches, yellowish-brown to brownish-yellow heavy silt loam; medium to strongly acid.

15 to 24 inches, brownish-yellow heavy silt loam to silty clay loam; slightly plastic when wet and hard when dry; medium to strongly acid.

24 to 32 inches, dark-brown to dark grayish-brown gravelly and waxy clay loam; abrupt change from the materials above this layer; tongues or lenses extend downward into the material below; medium to strongly acid.

32 inches +, loose stratified gravel and sand composed chiefly of sandstone and shale material; medium to strongly acid in the upper part but in a few areas gradually becomes neutral to slightly alkaline at depths of 8 to 10 feet.

The profile varies from that described in texture and thickness of the various layers and in depths to loose stratified gravel and sand. Included with this soil are a few small areas where loose gravel occurs at a depth of 15 to 18 inches. Also included are a few small bodies having an abnormally large quantity of gravel on and in the surface soil.

Use and management.—Practically all areas of Chenango silt loam are cultivated. Dairying is the main agricultural pursuit. Corn, wheat, oats, clover, alfalfa, timothy, and soybeans are the leading crops. The common rotation is made up of corn, wheat or oats, soybeans, and hay. Corn produces 35 to 60 bushels an acre, the yield depending upon moisture and the quantity of commercial fertilizer used. Yields are materially lower in seasons of abnormally low moisture. It is a common practice to use from 150 to 250 pounds of commercial fertilizer an acre with wheat, which yields 25 to 35 bushels an acre. Oats are not so well adapted as wheat, for moisture supplies late in spring and early in summer are low. Under present management oats yield 28 to 35 bushels an acre.

Sufficient lime to correct soil acidity must be applied before clover and alfalfa can be grown successfully. After acidity has been corrected and sufficient commercial fertilizer has been used, good stands of alfalfa are obtained. Small areas close to the larger population centers are used for sweet corn, tomatoes, and other vegetables.

Chenango silt loam, deep phase (Cr).—Except for having more loose stratified gravel at depths of 40 to 60 inches or more, this soil compares with Chenango silt loam in profile characteristics. The content of gravel on the surface and throughout the soil is usually small. Areas are associated with Chenango silt loam.

Its thicker subsoil makes this phase better for general farm crops than other Chenango soils. The deeper subsoil gives better water-holding capacity, and organic matter and plant nutrients are not leached out so readily. This soil is adapted to the same crops as Chenango silt loam but produces higher yields because it has better moisture-holding capacity.

Chenango silt loam, silted phase (Cu).—This is a soil occurring as long narrow irregular depressions or shallow basins at the base of terrace escarpments or slopes. It lies within areas of Chenango silt loam, and because of its position, has received an overwash of silt, clay, and fine sand from surrounding Chenango soils. Except for its brown to dark-brown surface soil, 10 to 18 inches deep, and slightly higher organic content, this phase has a profile similar to Chenango silt loam.

The soil is cropped about the same as the associated areas of Chenango silt loam and other Chenango soils, but crop yields are somewhat higher. Moisture conditions are better and the organic-matter content is higher than in Chenango silt loam.

Chenango silt loam, gently sloping phase (Ct).—Except for having thinner layers in the profile and less depth to stratified gravel and sand, this soil has profile characteristics similar to those of Chenango silt loam. Areas occur in association with Chenango silt loam, and accordingly, as narrow strips between terraces of different levels. Slopes range dominantly from 5 to 12 percent, but some extend to 15 percent.

The crops grown are about the same as on Chenango silt loam, but yields are somewhat lower. There is some danger that the surface soil, with its supply of plant nutrients, may be lost through erosion.

Chenango silt loam, eroded gently sloping phase (Cs).—Relatively narrow elongated areas of this soil lie between terraces of different levels. Slopes range dominantly from 5 to 12 percent but some are as great as 15. From 25 to 75 percent of the surface soil has been eroded away. Other than in loss of surface soil and shallower depth to loose gravel and sand, the profile is similar to that of Chenango silt loam. The present surface soil, 6 to 7 inches deep, is a brownish-yellow to yellowish-brown heavy silt loam to clay loam that is extremely low in organic matter.

Areas of this phase are farmed along with Chenango silt loam and associated soils. Crop yields are materially lower than those obtained on Chenango silt loam. A rotation that includes a large proportion of cover crops and hay crops should be used to prevent further erosion.

Conotton fine sandy loam (Cv).—This well-drained to somewhat excessively drained soil developed on low glaciofluvial outwash terraces of gravel and sand. It occupies nearly level areas between the alluvial (first bottom) soils and the higher lying terraces on which Chenango soils developed. It occurs in close association with Conotton loam and silt loam.

Profile in cultivated areas:

0 to 7 inches, light yellowish-brown very friable fine sandy loam; relatively low organic content; medium acid.

7 to 18 inches, yellowish-brown to pale reddish-brown fine sandy loam to light clay loam that becomes somewhat more coherent with depth; quantity of gravel variable; medium acid.

18 inches +, light grayish-yellow to light yellow loose stratified gravel and sand composed chiefly of sandstone and shale.

The profile may vary from that described in color, texture, and thickness of the various layers and in depth to loose gravel and sand. Included are a few areas on slopes of 5 to 15 percent. These more sloping areas are adjacent to stream channels and between the terraces and first bottoms. They have less depth to loose gravel and sand.

Use and management.—Conotton fine sandy loam is used principally for corn, wheat or oats, soybeans, and hay. A small acreage is in truck crops. Its light-textured surface soil and subsoil and relatively shallow depth to loose gravel and sand make this soil somewhat more droughty than Conotton loam and silt loam and not so well suited to the crops grown. Yields are materially lower than on Conotton silt loam. Alfalfa is probably better adapted than other crops, for it is more resistant to drought. The smoother slopes of the included sloping areas are farmed to the same crops as are grown on the rest of the soil, but are probably best suited to alfalfa-grass mixtures or similar meadow crops that withstand drought.

Conotton gravelly silt loam (Cw).—This well-drained soil developed on low-lying glaciofluvial outwash trraces. It occupies nearly level areas intermediate between soils of the flood plains and Chenango soils on the higher terraces. As with other Conotton soils, however, the surface is crossed by a few intermittent narrow shallow channels—the courses of temporary streams that cut across the terraces.

Profile in cultivated areas:

0 to 7 inches, brown or yellowish-brown friable gravelly silt loam; slightly acid.
7 to 16 inches, light-brown or pale reddish-brown gravelly silt loam; slightly acid.
16 to 24 inches, pale reddish-brown to brown gravelly clay loam; slightly acid.
24 inches +, stratified sand and gravel.

The quantity of gravel on the surface and in the soil is variable.

Use and management.—The soil is farmed with other Conotton soils. The same crops are grown as on Conotton silt loam, but yields are less because of droughtiness.

Conotton loam (Cx).—Low glaciofluvial outwash terraces of gravel and sand are occupied by this soil. Relief is nearly level, with a few shallow relatively narrow depressions in some areas. There is little surface runoff, and internal drainage is good to slightly excessive. Areas occupy positions intermediate between alluvial, or flood plains soils, and the higher lying terraces on which Chenango soils are developed.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to brown friable gritty loam; relatively low organic content; some water-worn gravel on the surface; medium acid.
7 to 15 inches, pale reddish-brown to yellowish-brown friable gritty heavy loam; medium acid.
15 to 22 inches, pale reddish-brown or yellowish-brown slightly waxy and gravelly light clay loam; slightly plastic when moist and hard when dry; medium acid.
22 inches +, light grayish-yellow to light-yellow loose stratified gravel, sand, and silt consisting chiefly of sandstone and shale material.

The profile varies from that described in thickness, texture, and color of the various layers and in depth to loose gravel and sand. Included are small areas with a gravelly loam surface soil and other small bodies where the depth to loose gravel is only about 12 to 14 inches.

Use and management.—Practically all of Conotton loam is cultivated to corn, wheat or oats, soybeans, and hay. It is somewhat more droughty than Conotton silt loam and produces somewhat lower crop yields.

Conotton loam, eroded gently sloping phase (CY).—This soil occupies dominantly the 5- to 12-percent slopes of the low terraces between the flood plain soils and the higher lying terraces on which Chenango soils are developed. About 25 percent or more of the surface soil has been removed by erosion. The present surface soil includes remnants of the former surface soil and some of the subsoil and is therefore a pale reddish-brown to yellowish-brown heavy loam. The subsoil is like that of Conotton loam. Soil areas of gravelly loam are included, and in these depths to gravel and sand may be only 12 to 15 inches. Also included are small areas where less than 25 percent of the surface soil has been removed.

The milder slopes are cropped with Conotton loam, but yield somewhat less. The steeper slopes, usually short, are commonly kept in grass.

Conotton silt loam (Cz).—This soil developed on low glaciofluvial outwash terraces of stratified gravel and sand. It usually occupies a position intermediate between the alluvial, or first-bottom, soils and the Chenango soils that lie on higher glaciofluvial outwash terraces. The relief is for the most part nearly level, but there are a few narrow shallow depressions that represent old temporary channels made by the streams during flood periods. There is little surface drainage, but internal drainage is good to excessive. The natural vegetation included oak, maple, ash, and elm.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to brown friable slightly gritty silt loam; relatively low organic content; medium acid.

7 to 16 inches, light yellowish-brown to pale reddish-brown silt loam to heavy silt loam that shows a somewhat more distinct reddish color when moist; medium acid.

16 to 25 inches, pale reddish-brown to brown slightly plastic (or waxy) gravelly clay loam; breaks into angular chunks of variable size; chunks are slightly plastic when moist and hard when dry; medium to strongly acid.

25 inches +, grayish-yellow to pale-yellow stratified loose gravel and sand, chiefly of sandstone and shale material, with smaller quantities of igneous and limestone gravel.

The profile varies in texture, color, and thickness of the various layers, in quantity of gravel in those layers, and in depth to loose gravel and sand. Included are a few small areas, principally along the outer edges of the terraces, where the soil has a gravelly silt loam surface texture.

Use and management.—Practically all of Conotton silt loam has been cleared of timber and used for corn, wheat or oats, hay, and soybeans. Moisture relations are somewhat better than those for the higher lying Chenango soils, and crops are not so frequently injured by flooding that growing fall-sown small grains and hay should be discouraged. The nearly level relief precludes erosion as a factor in farm management.

Corn usually follows hay crops in rotation. It yields 35 to 60 bushels or more an acre. The higher yields are obtained in years of more favorable moisture supply. Wheat yields 20 to 30 bushels an acre, and under present management, oats yield 25 to 35 bushels. The soil is probably better adapted to wheat than to oats, for it may become somewhat droughty early in summer, the time when oats make most rapid growth. From 150 to 250 pounds of commercial fertilizer an

acre is commonly used with corn and wheat; little fertilizer is applied with oats. Hay crops are a mixture of timothy, clover, alsike, and alfalfa, or any one of these grown alone. Lime must be used to correct acidity before legumes can be grown successfully. Alfalfa is probably better adapted than other hay crops, for it has a deeper root system and is therefore more drought resistant. Soybeans are taking a more important place in the rotation than formerly; they yield 15 to 25 bushels or more an acre. A relatively small area is in permanent pasture or forest.

Conotton silt loam, silted phase (C2).—This soil occurs in long, narrow, relatively shallow depressions or channels in association with Conotton silt loam. It has been washed from the surrounding areas of Conotton loam or has been deposited by the receding floodwaters of adjacent streams. The areas often form a boundary between terrace levels or grade into the nearby flood-plain soils. Profile characteristics are similar to those of Conotton silt loam, except the surface soil is thicker, or about 10 to 16 inches deep.

Because it is closely associated with Conotton silt loam and occurs in relatively narrow elongated areas, this soil is farmed about the same as Conotton silt loam and associated soils. Crops yield somewhat more than on the silt loam and are not injured by droughts.

Eifort silty clay loam (EA).—This imperfectly drained soil developed in relatively small areas where the thin (1 to 4-foot) beds of gray fire clay occur on relatively smooth relief. The natural vegetation was deciduous trees, including oak, maple, sycamore, and associated species.

Profile in cultivated areas:

0 to 6 inches, light grayish-brown to light brownish-gray slightly plastic silty clay loam; relatively low organic content; medium to strongly acid.

6 to 12 inches, light brownish-gray to gray heavy silty clay loam that contains a few light-yellow mottlings in the lower part; medium to strongly acid.

12 to 20 inches, mottled yellow and gray heavy plastic silty clay to clay; sticky when wet; medium to strongly acid.

20 inches +, gray heavy plastic clay containing an occasional thin layer of coal or clay shale.

The profile may vary from that described in thickness and texture of the various layers and in depth to the underlying fire clay.

Use and management.—Susceptibility to erosion, even on moderately sloping areas, make this soil not well suited to cultivated crops. A few areas are planted to corn, wheat, and clover, but yields are usually low. The soil is probably better for permanent pasture or forest. Applications of lime sufficient to neutralize acidity must be made before clover crops can be grown and before good stands of bluegrass and other pasture grasses can be obtained.

Eifort silty clay loam, eroded phase (EB).—This phase consists of areas from which 25 percent or more of the surface soil has been removed by erosion. Gullies occur on a few areas.

Profile in cultivated areas:

0 to 8 inches, light brownish-gray heavy silty clay loam; not so thick where severely eroded; medium to strongly acid.

8 to 16 inches, mottled yellow and gray plastic silty clay to clay; sticky when wet but hard when dry; medium to strongly acid.

16 inches +, gray heavy plastic clay.

Depth to the underlying gray fire clay varies considerably, depending on the extent of erosion. The fire clay is exposed in a few gullies.

Use and management.—This phase is seldom used for cultivated crops. It is better adapted to permanent pasture or forest.

Elkins silty clay (Ec).—This poorly drained soil occurs in depressions in the flood plains and in some of the slack-water terrace areas. Although the subsoil may be slack-water clay, the surface soil consists of recent alluvial deposits of sediments from residual sandstone and shale of the uplands. Owing to the low-lying position, this alluvium is very fine textured. The soil occurs in small widely scattered areas, including a few on terraces in association with Monongahela and Tyler soils.

Profile in cultivated areas:

0 to 8 inches, dark brownish-gray to dark-gray granular silty clay; high organic-matter content; medium acid.

8 to 16 inches, dark-gray plastic smooth dense slowly permeable clay, with mottlings and irregular splotches of gray, yellow, and brown; medium to strongly acid.

16 to 35 inches, mottled gray, yellow, and brown plastic clay; medium to strongly acid.

35 inches +, mottled gray, yellow, and brown laminated silt and clay.

Use and management.—Elkins silty clay is a fertile soil and, where adequately drained, is highly productive. It is used chiefly for corn, hay, or pasture. Under better management, including adequate drainage, corn yields 25 to 50 bushels, and alfalfa hay, 2½ tons an acre. Small grains are apt to lodge badly. When dry the soil shrinks, and the cracks formed in shrinking may injure roots of crops.

Gullied land (Eifort and Rarden soil materials) (Ga).—Very severely eroded areas of Eifort and Rarden soils make up this land type. Seventy-five percent or more of the surface soil has been removed by erosion, and many gullies extend to the fire clay or shale bedrock. The exposed material is light-gray clay or mottled red and yellow clay, both rather impervious to water. Slopes range to 30 percent. The soil materials of these areas vary from gray clay or red and yellow clay to fire clay and shale. As the material is rather impervious, much of the rainfall runs off, thus increasing erosion.

These areas are essentially nonagricultural, but it is desirable to have them covered with vegetation—either grass or trees. Once grass is established, it will furnish fairly good pasture.

Gullied land (Muskingum soil material) (Gb).—This land type consists of areas that were formerly Muskingum soils. Serious sheet and gully erosion have removed a large part of the surface and subsoil material. Bedrock is exposed in many places. Gullies occur with variable frequency but usually make the land unsuitable for cultivated crops or pasture. The land has been practically destroyed for present agricultural use and is best allowed to revert to forest.

Holston fine sandy loam (Ha).—This nearly level to gently sloping soil developed on slack-water deposits of fine sand, silt, and clay. It is the well-drained member of the soil catena that also includes the moderately well drained Monongahela and the imperfectly drained Tyler. Surface drainage is good to slightly excessive on the sloping areas, and internal drainage is good. The natural vegetation was a deciduous forest of oak, maple, hickory, and associated species.

Profile in cultivated areas:

0 to 7 inches, light yellowish-brown to grayish-brown fine sandy loam; relatively low organic content; medium to strongly acid.

7 to 16 inches, brownish-yellow to light-yellow fine sandy loam to loam; medium to strongly acid.

16 to 28 inches, light brownish-yellow to yellow silt loam or clay loam; somewhat compact in place but breaks into medium-sized subangular aggregates; medium to strongly acid.

28 inches +, brownish-yellow to yellow stratified layers of fine sandy loam, fine sand, silt, and clay extending to depths of 8 feet or more; medium to strongly acid.

The profile varies in texture and thickness of the various layers. A few areas have had 25 to 75 percent of the surface soil removed by erosion. Some areas have a lighter surface texture, and a few are mottled brown, yellow, and gray below a depth of 30 inches. Below a depth of 28 inches the thickness and sequence of the interbedded layers are extremely variable. Where the stratified layers contain an abnormally large quantity of clay, drainage is somewhat imperfect. A few areas in the vicinity of New Philadelphia and Schoenbrun have a light-brown surface soil that grades into sandy loam at a depth of 18 to 20 inches and contains some quartz, sandstone, and shale material. Included also are small areas along Conotton Creek where heavy clays are at a depth of 3 or 4 feet. Here the subsoil is heavier, more compact, and slightly mottled below a depth of 30 inches.

Use and management.—Practically all of Holston fine sandy loam is cleared of timber, and the greater part is cultivated. Since individual areas are small and rarely make up a unit as large as an ordinary farm field, the land is cultivated along with associated soils. The crop rotation includes corn, small grains, and hay. Small areas are planted to special crops, as melons, strawberries, tomatoes, and sweet corn. Corn yields 22 to 45 bushels an acre; wheat, 12 to 25; and oats, 20 to 30.

The hay crops are timothy, clover, and alfalfa, grown in mixture or alone. The surface and subsoil are strongly acid; therefore lime must be applied before clover and alfalfa can be grown successfully. Alfalfa is probably better adapted than clover. Organic matter should be turned under and liberal quantities of commercial fertilizer used to maintain and increase soil productivity. Crop rotations should include legumes or other green-manure crops.

Holston silt loam, eroded steep phase (Hb).—Areas of this phase occupy slopes greater than 18 percent on steep narrow terraces escarpments varying from 10 to 35 feet high. The soil material on these slopes is mainly of stratified silts and clays. More than 25 percent of the surface soil has been lost through erosion, and a few gullies have formed. Included are small areas showing only slight erosion. Also included are a few areas that consist of alternate layers of sands, silts, and clays. Most of these included areas have numerous gullies.

Most of Holston silt loam, eroded steep phase, has been cleared and is now in pasture or idle. Many areas have a covering of weeds, briers, and broomsedge; but some are entirely bare. This land is probably best used for forest.

Hornell silt loam (Hc).—This soil developed on relatively shallow deposits of heavy-textured glacial till of the Wisconsin glaciation. It is composed chiefly of shale and sandstone materials overlying bedrock of soft clay shale. The areas are mostly level to gently sloping, but a

few of them exceed 15 percent. The soil occurs in the extreme northwestern part of the county in association with Wooster and Canfield soils. Surface drainage is fair to good; internal drainage is restricted in the lower part of the subsoil.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to brownish-gray friable gritty silt loam; low organic content; medium to strongly acid.
7 to 18 inches, light brownish-yellow to pale-yellow friable heavy silt loam; medium to strongly acid.
18 to 30 inches, mottled gray, yellow, and brown heavy plastic silty clay to clay that breaks into medium to large blocky aggregates; sticky with wet and hard when dry; medium to strongly acid.
30 inches +, mottled gray and brown heavy plastic clay shale, usually several feet deep; clay similar to the clay shale on which the Keene soils are developed.

Profile variations are in color, thickness, texture, and numbers of rounded pebbles and gravel on the surface and throughout the soil. Included are two small areas along the Holmes County line that have brownish-gray silt loam surface soil to a depth of 6 or 7 inches, and under this, mottled yellow and gray heavy silt loam to silty clay loam. Here surface and internal drainage are poorer than in the typical soil. Also included are small areas where 25 to about 75 percent of the surface soil has been removed by erosion. The relief of such areas averages somewhat greater than typical for this soil but seldom exceeds 15 percent. The surface 6 or 7 inches of these areas is light brownish-yellow to pale-yellow heavy silt loam that is low in organic content.

Use and management.—About 30 percent of Hornell silt loam is in woodlots or woodland pasture. The rest is used for general farm crops and permanent pasture. The heavy texture of the subsoil and underlying material and somewhat imperfect internal drainage make this soil less productive than the associated Wooster and Canfield soils. Crop rotations are necessarily similar to those on the associated soils. Under present management corn yields 20 to 42 bushels an acre; wheat, 14 to 24; oats, 30 to 36; and mixed hay, 0.8 to 1.5 tons an acre.

Some areas, affected by springs located on the adjoining higher land, remain wet for long periods unless artificially drained. If productivity is to be maintained or increased, it is necessary to apply commercial fertilizer and sufficient lime to neutralize acidity. Permanent pasture is of fair to good quality, but most pastures can be improved by applying lime and commercial fertilizer and controlling weeds by proper grazing.

Tilth conditions on the included eroded areas are not so good as those on the typical soil, and the organic content is low. A rotation system consisting predominantly of cover crops and small grains should be used to assist in controlling erosion. Crop yields on these included areas are lower than those obtained on the typical soil.

Keene silt loam (Kb).—Noncalcareous yellowish-gray clay shale, interbedded with sandstone and siltstone, is the material on which this soil developed. Areas have 5- to 18-percent slopes and are associated with Muskingum soils in the uplands. The larger areas occur where clay shale occupies ridge tops. Surface drainage is moderate to rapid, and internal drainage is slow, especially in the lower part of the soil. The natural vegetation was deciduous trees, principally oak, ash, maple, and elm.

Profile in cultivated areas:

0 to 7 inches, light brownish-gray to yellowish-gray friable gritty silt loam; relatively low organic content; medium to strongly acid.

7 to 12 inches, grayish-yellow or pale brownish-yellow silt loam to heavy silt loam; medium to strongly acid.

12 to 16 inches, pale-yellow moderately compact silty clay loam; breaks into medium-sized subangular to angular aggregates; medium to strongly acid.

16 to 29 inches, grayish-yellow to dull-brown smooth plastic clay showing light-gray mottlings and colorations on cleavage faces and in root channels; breaks into medium-sized blocky aggregates, plastic when moist and hard when dry; impervious to plant roots and moisture movement; medium to strongly acid.

29 to 45 inches +, mottled yellow and gray heavy clay shale.

The profile may vary from the one described in color, texture, and thickness of the various layers and in depth to noncalcareous gray clay shale. In a few areas the silt loam surface soil grades abruptly at depths of 8 to 9 inches into the heavy clay subsoil. The subsoil in some areas is somewhat friable and permeable to moisture. In these the underlying soil material usually consists of thinly bedded layers of clay shale and siltstone.

Use and management.—Keene silt loam is one of the more important upland soils for the production of cultivated crops. About 95 percent of it has been cleared of forest and is either cultivated or in permanent pasture. About 40 percent of the cleared area is used for corn, oats or wheat, and hay. Corn yields 25 to 42 bushels an acre; wheat, 15 to 25; and oats, 25 to 38. A few small areas are used for potatoes, which produce moderate yields. The hay crops are mainly mixtures of clover and timothy, but a small acreage is in alfalfa. Alfalfa is grown more extensively than formerly.

Good rotation practices should be used to maintain and increase productivity and to retard erosion. For best crop yields all available organic matter, including barnyard manure and green-manure crops, should be turned under; commercial fertilizer should be used; and limestone should be applied to correct acidity. Limestone must be applied to correct soil acidity before clover and alfalfa can be grown successfully. The subsurface soil and subsoil are heavy-textured, and clover and alfalfa are therefore occasionally damaged by heaving during periods of alternate freezing and thawing. In general the rotation system is adjusted to dairying, the main agricultural pursuit (pl. 1, *A*).

Keene silt loam, eroded phase (Kc).—From 25 to 75 percent of the surface soil has been eroded from this phase. It is closely associated with other phases of Keene silt loam. The surface soil is slightly heavier textured than that of Keene silt loam and relatively low in organic content. A few areas with scattered shallow gullies are included.

The soil is cropped in about the same way as the soils with which it is associated, but because of erosion, usually yields less than Keene silt loam. To maintain productivity, organic matter and commercial fertilizer should be applied and a rotation consisting largely of hay crops used.

Keene silt loam, severely eroded phase (Kf).—Erosion has removed at least 75 percent of the surface soil from this phase, and in

places, all of the surface soil and part of the subsoil. Areas are small, widely separated, and usually associated with other phases of Keene silt loam. To a depth of 6 to 7 inches the surface is light brownish-yellow to pale-yellow heavy silt loam to silty clay loam, extremely low in organic content. The rest of the profile is similar to that of Keene silt loam.

Use and management.—This soil is cultivated to corn, wheat or oats, and hay, or is in permanent pasture. Tilth is poor, and the surface soil bakes and puddles easily. Crop yields are low. Management that uses all available organic matter, including green manure, and employs a high proportion of hay crops in the rotation is essential to prevent erosion and maintain productivity. The areas in permanent pasture support broomsedge, povertygrass, and small quantities of bluegrass and white clover. These pastures can be improved materially by using sufficient lime, applying fertilizer high in phosphorus, and controlling weeds.

Keene silt loam, very gently sloping phase (KH).—Areas of this phase occupy slopes of less than 5 percent, largely on ridge tops that have good surface drainage but imperfect underdrainage. The soil is derived from yellowish-gray clay shale. It is similar to Keene silt loam, but the various layers are better developed and somewhat thicker. The light brownish-gray silt loam surface soil is usually well developed, and the depth to mottling varies from 12 to 16 inches. The soil is moderately acid.

Use and management.—About 90 percent of this phase is farmed. As it occurs in small irregular tracts, it is usually farmed along with larger bodies of surrounding soils. The same general crops are grown as on associated soils, and yields are about the same or a little higher. The hazard of erosion is not so great as on Keene silt loam.

Keene silt loam, eroded very gently sloping phase (KE).—This soil occurs on 2- to 5-percent slopes from which 25 percent or more of the surface soil has been removed by erosion. The surface soil is light brownish-yellow to pale-yellow heavy silt loam, relatively low in organic content. A few areas with occasional gullies are included. This soil is closely associated with other phases of Keene silt loam, usually in relatively small areas.

The use of this soil is governed by the extent of the associated soils. Tilth is not so good as for the uneroded very gently sloping phase. The greater part of the soil is cultivated to corn, wheat or oats, and hay. Crops yield somewhat less than on the very gently sloping phase of Keene silt loam.

Keene silt loam, eroded steep phase (KD).—This phase is made up of areas on 18- to 30-percent slopes that have lost 25 to about 75 percent of the original surface soil through erosion. A few areas with scattered gullies are included. The soil is associated with other phases of Keene silt loam and with Muskingum silt loam. In profile characteristics it is similar to the eroded phase of Keene silt loam, except its various layers are thinner and its depth to clay shale is less.

A few areas of this phase are cultivated, but crop yields are relatively low. The soil is not adapted to cultivated crops because it is too sloping and is susceptible to further erosion. The greater part is in permanent pasture of fair to low quality (pl. 1, *B*).

Keene silt loam, severely eroded steep phase (KG).—Slopes of this phase are greater than 18 percent. Erosion had removed 75 percent or more of the surface soil, or all of the surface soil and a part of the subsoil. The surface soil, 6 to 7 inches deep, is pale-yellow heavy silt loam to silty clay loam extremely low in organic content. Gullies are numerous in many areas. The soil is associated with the other phases of Keene silt loam.

Use and management.—Steepness of slope, eroded condition, and susceptibility to further erosion, make this phase unsuitable for cultivated crops. It is better adapted to forest or to permanent pasture. Tilth is poor; the surface bakes and puddles easily under cultivation. In the past the land was cleared of timber and cropped or used for permanent pasture; now only a few small areas are cultivated to corn, wheat, and hay. Yields are extremely low. Most of the land is in permanent pasture or left idle. The pasture growth is a mixture of poverty grass and broomsedge, with smaller proportions of bluegrass and white clover. Broomsedge, briers, sassafras, and sumac grow on the idle land.

Keene-Rarden-Eifort silty clay loams, eroded steep phases (KA).—This is a complex of eroded steep phases of Keene, Rarden, and Eifort silty clay loams on slopes greater than 18 percent. More than 25 percent of the surface soil has been removed by erosion, and some areas have many gullies. Surface drainage is rapid; internal drainage is somewhat restricted in the subsoil.

The medium to strongly acid surface soil, 6 to 8 inches deep, varies from grayish-yellow to light grayish-brown heavy silt loam to silty clay. The subsoil varies from mottled light-gray and yellow to brownish-yellow or reddish-brown silty clay to clay. Outcrops of the underlying bedrock alternate from noncalcareous gray fire clay to clay shale. The bedrock formations are variable in thickness but are sufficiently thin to prohibit the mapping of the individual soils. Thus, the complex has the characteristics of all three soils, and the profile varies within short distances, depending upon the kind of material from which it is developed.

All of this complex has been cleared of timber, but it is now idle or in permanent pasture. Because of the numerous shallow to deep gullies and general eroded condition of the surface soil, this complex is best used for permanent pasture or forest.

Killbuck silt loam (KK).—Light-colored alluvial deposits on dark soil materials of the larger stream flood plains constitute this soil. Surface drainage is fair; underdrainage, poor.

Profile in cultivated areas:

0 to 12 inches, grayish-brown or brownish-gray friable silt loam; lower 2 inches show some brown streaking; medium acid.

12 to 18 inches, very dark-gray or very dark brownish-gray heavy silty clay loam; medium acid.

18 to 24 inches, mottled dark gray, yellow, and brown heavy silty clay loam to silty clay.

24 inches +, mottled yellow, brown, and gray silty clay.

The depth of the overlying light-colored soil varies from 8 to 16 inches or more.

Use and management.—Most of this soil is used for pasture, but a few areas have been drained and cultivated. Under present manage-

ment corn yields 35 to 63 bushels, and hay—commonly mixed timothy, alsike, and redtop—yields 1½ to 2 tons an acre. The areas not drained are best used for pasture.

Lobdell silt loam (LA).—This nearly level soil developed on alluvium in association with well-drained Chagrin silt loam. It occurs along the Tuscarawas River and other streams that flow from the glacial area north of the county. Internal drainage is somewhat restricted.

Profile in cultivated areas:

- 0 to 9 inches, grayish-brown to pale-yellow friable silt loam; slightly acid to neutral.
- 9 to 18 inches, brownish-yellow to pale-yellow heavy silt loam; slightly acid to neutral.
- 18 inches +, mottled gray, yellow, and brown silt loam to silty clay loam containing dark concretions of iron material; variable texture and color but layer commonly consists of alternate layers of silt, clay, and fine sand.

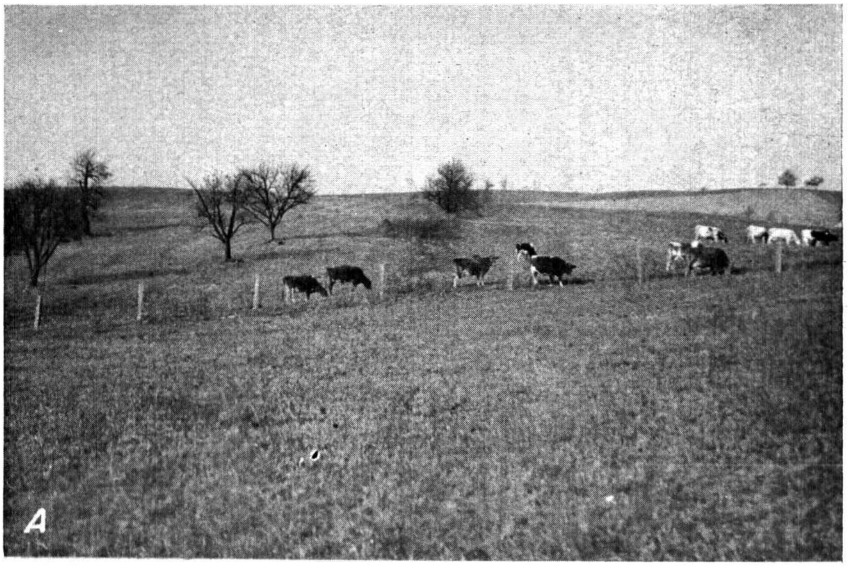
The depth to mottling is variable. The better drained areas are mottle-free to 25 inches. Included are some areas that have a loam or fine sandy loam surface texture.

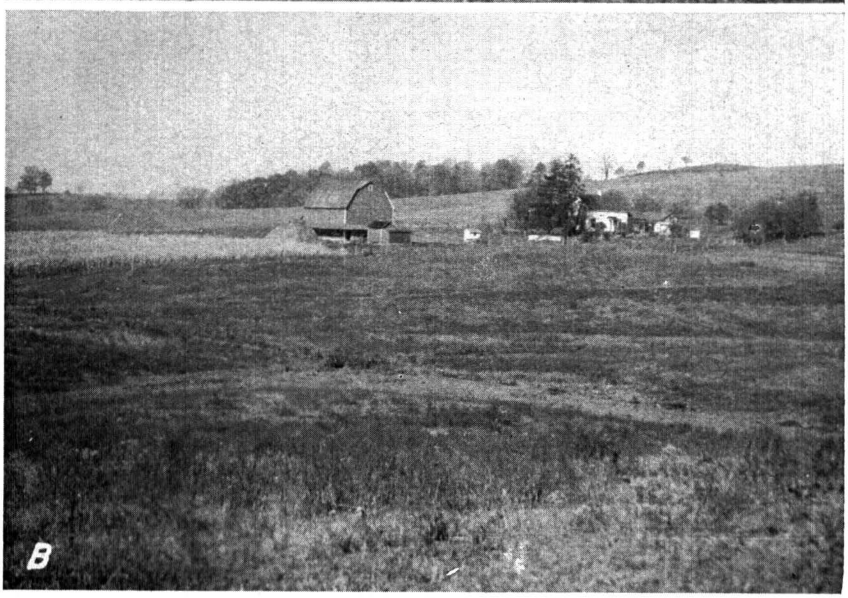
Use and management.—Most of Lobdell silt loam is cultivated. Under present management, corn, the most important crop, yields 30 to 54 bushels an acre. The soil is not well adapted to small grains because of the danger of flooding. Some areas have been tiled. Hay crops commonly consist of a mixture of timothy and clover, though there is an increased interest in alfalfa-grass mixtures. The cropping system used and yields obtained depend largely upon the frequency of floods. The crops grown on the included loam and fine sandy loam are about the same as those grown on Lobdell silt loam. The wetter areas of these inclusions are in permanent pasture.

Lobdell silt loam, high-bottom phase (LB).—In profile characteristics this phase is similar to Lobdell silt loam. Its occurrence on slightly higher elevations above the streams, where flood hazard is not so great, permits a somewhat more diversified system of crop rotation. Corn, wheat or oats, soybeans, and hay are the principal crops. In any given year yields compare with those obtained on Lobdell silt loam, but the average over a period of 10 years is higher on this phase because there is less loss from floods.

Made land, mine pits, and dumps (M).—This nonagricultural land type includes coal-mine dumps, rock quarries, coal-stripping areas, clay pits, gravel pits, and filled land. Pits from which gravel is obtained for road construction and industrial purposes usually occur on stream terraces. A number of the large dumps made by strip coal mining, principally those near Dundee, have been reforested, but others are barren or support only a scant growth of brush, briers, and some coarse grass. Made land also includes waste material and refuse adjacent to the refractory plants.

Monongahela silt loam (MA).—This soil developed on slack-water deposits of noncalcareous silt, clay, and fine sand. It is the moderately well drained member of the soil catena that also includes the well-drained Holston and the imperfectly drained Tyler. The relief is nearly level to gently undulating, the slopes not exceeding 5 percent.





A, Dairy cattle feeding on rotation pasture on Keene silt loam; small apple orchard on left.

B, Farmstead on Keene soils. Corn on left of barn and pasture in foreground on Keene silt loam, eroded phase; permanent pasture on Keene silt loam, eroded steep phase, in left background.

A, Rotation cropland on nearly level Monongahela silt loam in foreground and poor grade pasture on Muskingum silt loam, severely eroded steep phase, in background. Note the numerous gullies on the Muskingum soil, probably the result of overgrazing or improper erosion control.

B, Typical fair to low quality permanent pasture on Monongahela silt loam in foreground and Muskingum silt loam, eroded steep phase, in background.

Most areas occupy terraces in the valleys of the Tuscarawas River and Conotton, Stillwater, and Sugar Creeks. The native vegetation was deciduous trees, including oak, maple, elm, and ash.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light brownish-gray smooth friable silt loam of relatively low organic content; medium to strongly acid.
7 to 18 inches, pale-yellow or light brownish-yellow friable heavy silt loam to silty clay loam that breaks into coarse granules or small subangular aggregates; medium to strongly acid.
18 to 30 inches, mottled gray, yellow, and brown somewhat plastic silty clay loam to silty clay; somewhat impervious to moisture and plant roots; medium to strongly acid.
30 inches +, mottled gray, yellow, and brown interbedded layers of clay, silt, and fine sand; thickness of layers variable; medium to strongly acid in upper part but gradually changes to neutral or slightly alkaline below a depth of 7 or 8 feet.

Profile variations are in color, texture, and thickness of the various layers. The subsurface and subsoil of a few small included areas have a loam texture and are not so heavy textured as Monongahela silt loam. Also included are small areas that have a heavy silt loam surface soil to a depth of 5 or 6 inches and then, after an abrupt change, tough dense clay. Such areas are somewhat more poorly drained than the typical soil.

Use and management.—Approximately 95 percent of Monongahela silt loam is cleared of timber and now farmed. Crop rotation systems in general use include corn, wheat or oats, hay (pl. 2, *A*), and an occasional crop of soybeans. Corn usually follows hay or soybeans in rotation; it yields 24 to 54 bushels an acre. Under present management wheat follows either soybeans or corn and yields 13 to 26 bushels an acre. Oats are not so well adapted as wheat; yields range from 20 to 35 bushels an acre. Hay crops (pl. 2, *B*) are a mixture of timothy, clover, and alfalfa or either clover or alfalfa grown alone. Soybeans, increasingly important in crop rotations, usually follow corn or small grains and yield 15 to 25 bushels an acre.

Commercial fertilizer is generally used for corn and wheat; some farmers fertilize soybeans and clover. To obtain better yields, tile drains should be installed in some areas, especially those where the heavy clay material is less than 3 feet deep. The stands of legumes and their yields depend upon application of enough lime to neutralize soil acidity and the use of a commercial fertilizer relatively high in phosphate.

Monongahela silt loam, eroded phase (Mc).—This phase occurs on terrace areas where slopes range from 0 to 5 percent. It has developed on stratified silt and clay with some sand and is associated with the other Monongahela soils. Erosion has removed 50 percent or more of the surface soil. The present surface soil, 6 or 7 inches deep, is pale-yellow heavy silt loam to silty clay loam, extremely low in organic content.

Loss of part of the surface soil has caused poor tilth and lowered the supply of plant nutrients. Crop rotations are governed largely by the associated soils but usually include corn, wheat or oats, and hay. Crop yields are considerably lower than those obtained on Monongahela silt loam.

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Monongahela silt loam, undulating phase (MF).—Small bands of this soil occur dominantly on 5- to 10-percent slopes between different terrace levels or at the junction between terrace and upland areas. In profile characteristics it is similar to Monongahela silt loam, but its surface soil is usually somewhat heavier textured and lower in organic content, and the various layers are thinner. Where this soil lies between terraces and uplands there is usually a narrow band where material has washed from the surrounding uplands onto the surface soil. Areas having this overwash approach Zaleski silt loam in characteristics but are included with this phase because of small extent.

Most of this phase is cultivated to corn, wheat, and hay, but yields are somewhat less than those obtained on Monongahela silt loam. Erosion is potentially severe. To keep erosion under control it is necessary to incorporate all available organic matter and to apply erosion control practices.

Monongahela silt loam, eroded undulating phase (MD).—This phase is on slopes of 5 to 10 percent and occurs in long narrow bands between different terrace levels or at the junction between terrace and upland areas. Approximately 50 percent or more of the surface soil has been removed by erosion. The surface 6 or 7 inches, or that part of the soil now plowed, is pale-yellow heavy silt loam to silty clay loam extremely low in organic content and poor in tilth conditions.

Rotations practiced on this phase are governed largely by the associated soils. Crop yields are considerably lower than those on Monongahela silt loam. Erosion control should be practiced to retard loss of surface soil. Any crop rotation should consist dominantly of cover crops and hay crops, and the soil should never be allowed to remain idle during winter and early spring.

Monongahela silt loam, light-textured subsoil phase (ME).—Lighter textured subsoil and underlying material distinguish this soil from Monongahela silt loam. To a depth of 15 or 20 inches the two are essentially the same, but below that depth this phase has alternate layers of brownish-yellow silt, fine sand, and gravelly material. Drainage conditions are somewhat better in this soil, but mottling occurs at about the same depth as in Monongahela silt loam.

Practically all of this phase is now cultivated. It warms earlier in spring than Monongahela silt loam and produces slightly better yields.

Monongahela silt loam, eroded light-textured subsoil phase (MB).—Except for having lost 50 percent or more of its surface soil through erosion, this phase is similar to the light-textured subsoil phase of Monongahela silt loam. It occurs in association with the other Monongahela soils on the terraces developed from slack-water material. The surface soil, 6 or 7 inches deep, is pale-yellow to light brownish-yellow heavy silt loam to silty clay loam very low in organic content.

Use and management.—Tilth is poor, and careful management and crop rotation must be used to prevent further erosion. The soil is cultivated to corn, wheat or oats, and hay, but yields are considerably lower than on Monongahela silt loam, light-textured subsoil phase.

A few areas are in permanent pasture of fair to poor quality. If productivity is to be maintained or increased, commercial fertilizer and organic matter must be applied regularly.

Muskingum fine sandy loam (MJ).—This well-drained to excessively drained soil developed largely on coarse-grained sandstone. It occurs on undulating to sloping relief, mostly on slopes of 5 to 18 percent. The small scattered areas are associated with other Muskingum soils. Many are less than 5 acres in extent and occur on the higher somewhat isolated ridges.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown or grayish-yellow fine sandy loam; relatively low organic content; strongly acid.

7 to 18 inches, light-yellow or light brownish-yellow sandy loam to loamy sand containing various quantities of partly weathered coarse-grained sandstone fragments; strongly acid.

18 inches +, partly weathered coarse-grained sandstone bedrock.

The profile varies in texture and thickness of the layers and in depth to sandstone bedrock. The depth to bedrock is extremely variable. In short horizontal distances the depth may vary from 10 to 25 inches.

Use and management.—Agriculturally, Muskingum fine sandy loam is relatively unimportant. Only about 5 percent is cultivated to farm crops; the rest is in forest, idle land, or permanent pasture. It is not well adapted to cultivated crops, and yields are generally low. The idle land includes areas formerly cultivated that are now covered with briers, brush, and various weeds. The growth in permanent pastures is a mixture of broomsedge and poverty grass with small quantities of bluegrass. This soil is probably better for permanent pasture or forest than cultivated crops.

Muskingum fine sandy loam, eroded phase (MK).—This phase has lost 25 percent or more of its surface soil through erosion. It occurs on the ridge tops and slopes in association with the other phases of Muskingum fine sandy loam. Slopes do not exceed 18 percent. The surface soil, a light brownish-yellow to yellowish-brown fine sandy loam, is low in organic content and contains many small partly weathered sandstone fragments. The depth to sandstone bedrock is less than for Muskingum fine sandy loam.

A few narrow ridge tops have been included. Also included are a few severely eroded areas that have lost 50 percent or more of the surface soil, or all of the surface soil and a part of the subsoil. In these areas bedrock is closer to the surface than in the typical eroded phase.

Use and management.—This phase has been cleared of timber and is now in permanent pasture, cultivated, or left idle. The growth in permanent pastures is poverty grass and broomsedge mixed with relatively small proportions of bluegrass and white clover. Use of sufficient lime and commercial fertilizer and the control of weeds would increase the livestock-carrying capacity of permanent pastures. Corn, wheat, and a mixture of timothy and clover are grown; yields are slightly lower than those obtained on Muskingum fine sandy loam. The idle land consists of areas once cultivated that now support a growth of broomsedge, briers, sassafras, sumac, and various weeds. The included severely eroded areas, unadapted to cultivated crops,

are in low quality pasture or idle. Poverty grass, briers, sassafras, and weeds grow on the idle land.

Muskingum fine sandy loam, very gently sloping phase (Mo).—Slopes for this phase are less than 5 percent, and erosion has not been significant. The areas are mapped on broader ridge tops in association with other phases of Muskingum fine sandy loam. The soil profile is similar to that of Muskingum fine sandy loam.

Much of this phase is cultivated to corn, wheat or oats, and hay. Yields are somewhat higher than those obtained on Muskingum fine sandy loam. Part of the area is in permanent pasture, and a smaller part is in timber.

Muskingum fine sandy loam, steep phase (Mn).—The long narrow bands of this soil, generally occur on the upper part of slopes adjacent to ridge tops. The profile is somewhat similar to that of Muskingum fine sandy loam, except the surface and subsoil layers are thinner, are usually lower in organic content, and contain more of rounded partly weathered rock fragments.

Use and management.—Because of its 18- to 30-percent slopes, this soil is susceptible to erosion when cultivated and is better for forest or permanent pasture than for cultivated crops. Approximately 70 percent or more is in forest—a mixture of oak, maple, yellow-poplar (tuliptree), hickory, and ash. Only about 5 percent is used for corn, wheat, and hay. Crop yields are considerably lower than those obtained on Muskingum fine sandy loam. The area not forested is in permanent pasture or is idle. Permanent pastures support poverty grass, broomsedge, weeds, and a small proportion of bluegrass and white clover.

Muskingum fine sandy loam, eroded steep phase (Ml).—This soil occurs on slopes of 18 to 30 percent and is usually associated with the steep phase of Muskingum fine sandy loam. About 75 percent of the surface soil has been removed by erosion. Drainage is excessive and there are occasional gullies. The surface soil, 6 or 7 inches of light brownish-yellow fine sandy loam, is low in organic content and contains a considerable quantity of small partly weathered sandstone fragments. The depth to sandstone bedrock is usually less than 12 inches. Included are small severely eroded areas where most of the surface soil and a part of the subsoil have been eroded. Many of these areas contain gullies, some of which extend down to the bedrock. For the included areas the depth to bedrock averages less than 10 inches.

Use and management.—Areas of this phase have been cleared of timber, and in the past have been used either for permanent pasture or cultivated crops. Now, a large part of the area is in permanent pasture or idle; only a small percentage is cultivated. Crop yields are low because the soil has unfavorable slopes, a shallow profile, and a low supply of organic matter and plant nutrients. Broomsedge, poverty grass, and small amounts of bluegrass and white clover grow in the permanent pastures. The idle areas support weeds, sumac, sassafras, broomsedge, and a few scattered clumps of bluegrass and clover. This phase is better for forest than for permanent pasture or cultivated crops. The included severely eroded areas are of extremely low agricultural value and are best used for forest.

Muskingum fine sandy loam, very steep phase (MP).—This phase occurs on slopes greater than 30 percent. Profile characteristics are similar to those of Muskingum fine sandy loam, except the surface and subsoil layers are considerably thinner and depth to bedrock is less. Practically all areas are in forest—probably the best use, because slopes are steep and the soil droughty.

Muskingum fine sandy loam, eroded very steep phase (MM).—Slopes for this soil exceed 30 percent, and up to 75 percent of its surface layer has been eroded away. A few areas have occasional gullies. The soil is associated with other phases of Muskingum fine sandy loam. It includes a few severely eroded areas from which 75 percent of the surface soil, or all of the surface soil and a considerable part of the subsoil, has been removed by erosion. Gullies extend to bedrock in several of these included areas.

At present this soil is in low quality permanent pasture or idle. Because it is steep and susceptible to erosion, the land is better for forest or permanent pasture than for cultivated crops. The included severely eroded areas are not suitable for either permanent pasture or cultivated crops and are best used for forest.

Muskingum silt loam (MQ).—A complexity of conditions is represented in this soil, which varies from place to place according to the character and thickness of the underlying interbedded sandstone, siltstone, and shale. It is widely distributed over the county, occupying narrow ridge tops and slopes of the upland areas. Slopes range from 5 to 18 percent but are mostly greater than 8 percent. Surface runoff is good to excessive, and internal drainage is good to somewhat excessive. The native vegetation is deciduous forest, principally oak and hickory with associated species in lesser numbers.

Profile in wooded areas:

0 to 2 inches, dark brownish-gray to dark yellowish-gray gritty friable silt loam; relatively high organic content, medium to strongly acid.

2 to 7 inches, yellowish-gray to brownish-gray gritty friable silt loam; low organic content; medium to strongly acid. (In cultivated areas this and the layer above are mixed together, giving a light yellowish-gray to light brownish-gray gritty friable silt loam that is low in organic content.)

7 to 21 inches, light brownish-yellow to yellowish-brown gritty friable silt loam to heavy silt loam; contains many small angular sandstone and shale fragments; medium acid.

21 inches +, interbedded sandstone, siltstone, and shale bedrock.

Another characteristic profile:

0 to 2 inches, grayish-brown to brown friable silt loam; relatively high organic content; medium to strongly acid.

2 to 7 inches, yellowish-gray to light brownish-yellow silt loam; low organic content and relatively free of rock fragments. (This and the above layer are mixed together in cultivated areas, giving a light brownish-yellow smooth friable silt loam that is relatively low in organic content.)

7 to 14 inches, yellowish-brown to brownish-yellow friable silt loam containing few, if any, rock fragments; medium acid.

14 to 20 inches, yellowish-brown to brownish-yellow heavy silt loam to silty clay loam with a few light-gray mottlings or streaks in the lower part; medium acid.

20 to 22 inches, light-yellow to light brownish-yellow friable gritty silt loam containing many small partly weathered sandstone and shale fragments; medium acid.

22 inches +, interbedded shale and sandstone bedrock.

This soil varies in color, texture, and thickness of the various layers and in depth to and kind of underlying bedrock formation. Where it is developed predominantly on siltstone and shale, the subsoil is somewhat heavier textured than typical. Since the bedrock formations are in many places thinly bedded and lie nearly horizontal, areas of Muskingum silt loam mapped on the sloping positions have developed from a variety of materials. Thus, the profile changes considerably in short horizontal distances.

Use and management.—Areas of Muskingum silt loam occurring on the broader ridge tops or on relatively uniform slopes are cultivated to corn, wheat or oats, and hay. The soil is not well adapted to grain crops because it is shallow, susceptible to erosion, and naturally low in organic matter and plant nutrients. In common practice 150 to 250 pounds of commercial fertilizer an acre are applied for corn; some farmers use a side dressing of nitrate fertilizer or superphosphate in addition. For wheat, a crop probably better adapted than corn, most farmers use 150 to 250 pounds or more of commercial fertilizer an acre.

Among the hay crops are alfalfa, and clover and timothy mixed. Enough lime to neutralize soil acidity must be used to grow clover and alfalfa successfully. Lime is usually applied at least once in a rotation when the soil shows need for it. Alfalfa is gaining in importance and gives good to excellent stands if the land is limed, sufficient commercial fertilizer high in phosphate used, and a good seedbed is prepared. A few commercial apple and peach orchards give fair to good yields when properly maintained.

Much of this soil is in permanent pasture supporting principally poverty grass, broomsedge, cinquefoil, various weeds, briers, and a sparse growth of redtop, bluegrass, and white clover. A good pasture-improvement program, including proper liming, fertilization, and control of weeds, will greatly increase the livestock-carrying capacity. Many areas that have been cleared of trees and cultivated are now idle and grown up to briers, sumac, sassafras, and a variety of weeds.

Muskingum silt loam, eroded phase (Ms).—Areas of this phase have lost 25 to 75 percent of the surface soil through erosion. A few of them have occasional gullies. The surface soil, or the upper 6 or 7 inches of the profile, is light brownish-yellow to light yellowish-brown silt loam, which is extremely low in organic content and usually contains many small partly weathered sandstone and shale fragments. Bedrock of sandstone, siltstone, and shale occurs at a somewhat shallower depth than in Muskingum silt loam.

Use and management.—Areas of this phase have been cleared of timber and used for cultivated crops or permanent pasture. At present corn, wheat, and hay (pl. 3, *A*) are grown, and yields are somewhat lower than those obtained on Muskingum silt loam. This phase is probably best suited to alfalfa and clover or permanent pasture. To establish a satisfactory stand of legumes or permanent pasture, apply sufficient lime and commercial fertilizer. The more sloping areas are probably better for permanent pasture than cultivated crops.

Muskingum silt loam, severely eroded phase (Mv).—This phase occupies 5- to 18-percent slopes where 75 percent or more of the surface soil, or all of the surface soil and part of the subsoil, has

been removed by erosion. Gullies occur frequently. The surface layer, 6 or 7 inches deep, is light brownish-yellow to light yellowish-brown silt loam to heavy silt loam. It is very low in organic content and contains many small sandstone and shale fragments. The depth to sandstone, siltstone, and shale bedrock, usually about 12 to 14 inches, is considerably less than for Muskingum silt loam.

Use and management.—This soil was once cultivated, but most of it is now idle or in permanent pasture. The depth to underlying bedrock and the shallowness of the surface soil and subsoil make this phase somewhat droughty, and it is occasionally difficult to maintain good pasture. Many of the permanent pastures are of poor quality, consisting principally of poverty grass, broomsedge, and weeds, with a small proportion of bluegrass and white clover. Briers, weeds, sassafras, and sumac, and a small proportion of bluegrass grow on idle areas. This phase is probably better for permanent pasture or forest than cultivated crops. Permanent pastures can be improved greatly by using sufficient lime and commercial fertilizer and by controlling weeds. Attempts to grow alfalfa have met with varying success.

Muskingum silt loam, colluvial phase (Mr).—Material washed from higher lying areas of Muskingum soils is the source of this phase. It occurs at the heads of drainageways and along the lower part or at the foot of steeper slopes. It has no definite profile, as it consists of a mixture of silt, fine sand, clay, and rock fragments of various sizes. The surface soil, 6 to 7 inches deep, is usually grayish-brown or light yellowish-brown silt loam of variable but usually relatively low organic content. This layer is underlain by a mixture of silt loam, silty clay loam, and some clay in which there are many sandstone and shale fragments. Sandstone and shale bedrock occurs at depths of 30 to 40 inches. Included are small areas from which 25 percent or more of the surface soil and, in some instances, part of the subsoil has been eroded.

Use and management.—Utilization of this soil is limited by the relief and extent of the adjoining soils. Areas associated with terrace or alluvial soils are cultivated in about the same way as the associated soils. Crop yields vary considerably, depending upon the composition of the colluvial material. Under present management corn yields 32 to 56 bushels an acre; wheat, 15 to 28 bushels. The included eroded areas are used chiefly for hay or pasture, but a few are cropped along with adjacent terrace areas. According to the extent of erosion, the quality of pasture varies from fair to poor.

Muskingum silt loam, very gently sloping colluvial phase (Mz).—Slopes for this phase are less than 5 percent, but it is otherwise similar to the colluvial phase. The two soils are in somewhat isolated areas occupying similar positions, but the more gentle slopes of this phase make it somewhat better suited to cultivated crops. The crops grown—corn, wheat, and hay—yield somewhat more than they do on the colluvial phase. Much of the land is in permanent pasture, and a few areas are used as farmstead sites.

Muskingum silt loam, steep phase (My).—This soil occurs on slopes of 18 to about 30 percent. In profile characteristics it is essentially the same as Muskingum silt loam, except its surface and subsoil layers are thinner and it is usually not so deep to bedrock.

The soil is mapped in association with the other phases of Muskingum silt loam.

Practically all this phase is now in forest consisting chiefly of oak and hickory. Small areas are in permanent pasture. The land is not well adapted to cultivated crops, for it is susceptible to erosion and droughty.

Muskingum silt loam, eroded steep phase (MT).—Areas with slopes of 18 to about 30 percent are occupied by this phase. From 25 to 75 percent of the surface soil has been removed by erosion. Occasional gullies occur in a few areas. The profile is similar to that of the eroded phase of Muskingum silt loam, but the various layers are thinner and the depth to bedrock is considerably less.

Use and management.—This steep soil has all been cleared of forest and is now in permanent pasture, cultivated, or left idle. Only a few areas are planted to corn (pl. 3, *B*), wheat, or hay. Yields are low. Fair to good stands of alfalfa have been obtained after applying sufficient lime and fertilizer. Permanent pastures are of fair to poor quality but can be greatly improved by properly controlling weeds and by using lime and a commercial fertilizer relatively high in phosphate.

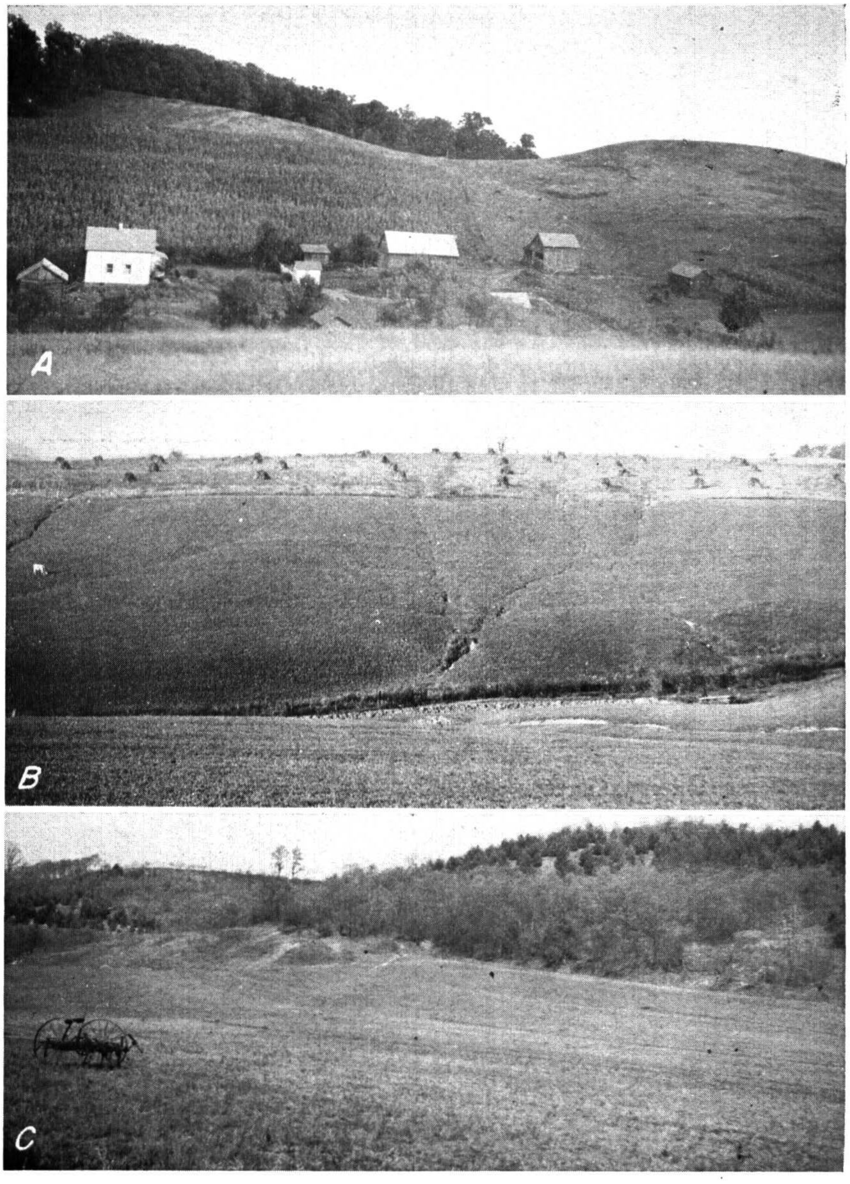
Muskingum silt loam, severely eroded steep phase (Mw).—More than 75 percent of the surface soil, or all the surface soil and part of the subsoil, has been removed from this phase by erosion. The remaining surface material is a light brownish-yellow to light yellowish-brown heavy silt loam containing many sandstone, siltstone, and shale rock fragments. The organic content is extremely low, and in numerous areas rock fragments interfere with cropping. The depth to bedrock probably is about 10 to 12 inches. Slopes of this phase range from 18 to 30 percent.

Use and management.—Areas of this soil have been cleared of timber and were once used for permanent pasture or crops. Now, they are in permanent pasture or left idle. The permanent pasture is usually of poor quality, consisting largely of broomsedge, poverty grass, and briers, with only a small portion of bluegrass and white clover. The idle land includes areas once cultivated and now supports broomsedge, briers, sassafras, and sumac, and small patches of bluegrass. This phase is not adapted to cultivated crops and is better suited to forest or permanent pasture (pl. 3, *C*).

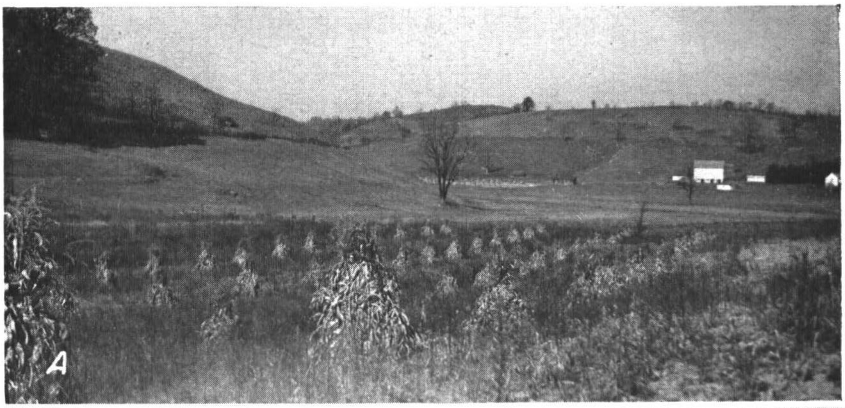
Muskingum silt loam, very steep phase (M_2).—Slopes of this phase are greater than 30 percent. The profile is comparable with that of Muskingum silt loam, but the various layers are considerably thinner and the depth to bedrock is less. Sandstone and shale fragments on the surface and through the soil usually interfere with cultivation.

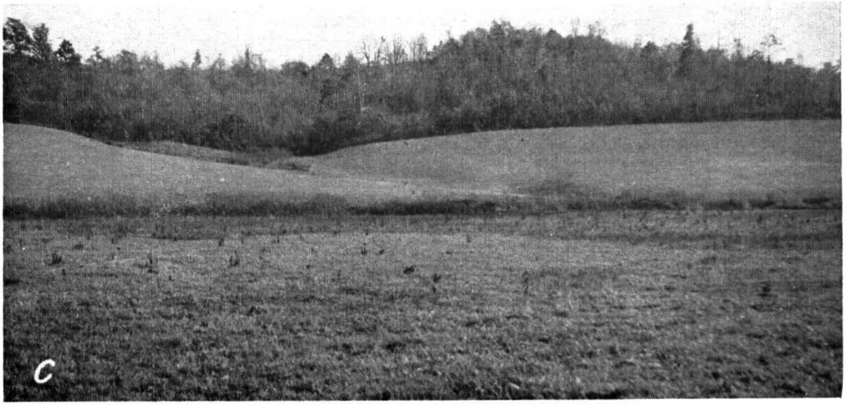
Use and management.—Practically all areas of this phase are in forest consisting mainly of oak, hickory, buckeye, and associated species. A few small areas are in permanent pasture, but it is difficult to maintain good pastures because the soil is very steeply sloping and consequently susceptible to erosion. Forest is a better use for this soil than either permanent pasture or cultivated crops.

Muskingum silt loam, eroded very steep phase (MU).—Slopes for this phase are greater than 30 percent, and 25 to 75 percent of the



A, Farmstead on Muskingum soils. Corn on Muskingum silt loam, eroded phase, in background; permanent pasture on severely eroded steep phase on right; and rotation pasture of timothy and clover in foreground.
B, Cultivated Muskingum soils: Corn on Muskingum silt loam, eroded and eroded steep phases, in background; rotation pasture on severely eroded steep phase in background. Note gullies in the pasture.
C, Locust and pine plantings—an effective erosion control—on Muskingum silt loam, severely eroded steep phase, in background.





A, Typical landscape in area of soils derived from sandstone and siltstone materials: Corn on Philo silt loam; rotation pasture (lower slopes) on Muskingum and Tuscarawas silt loams; and permanent pasture (upper slopes) on Muskingum silt loam, eroded steep phase.
B, Farmstead showing comparative land utilization. Cultivated field on nearly level Philo silt loam in foreground and permanent pasture with scattered shrubs and trees on Muskingum silt loam, severely eroded phase, in background.
C, Philo silt loam in foreground; rotation pasture on Tuscarawas and Muskingum silt loams in center; and cut-over forest on Muskingum silt loam, steep phase, in background.

surface soil has been eroded away. A few areas are gullied. The soil has been cleared of timber and is now largely in permanent pasture or idle. Permanent pasture is of fair to poor quality; idle land supports largely poverty grass, broomsedge, briers, sassafras, and sumac. Steep slopes and susceptibility to erosion make this phase better for forest or pasture than cultivated crops.

Muskingum silt loam, severely eroded very steep phase (Mx).—This soil has slopes greater than 30 percent. Erosion has removed 75 percent or more of its surface soil, or all of the surface soil and part of the subsoil. Many small gullies, some of which extend to bedrock, are present in most of the areas. The surface and subsoil are usually less than 12 inches thick, and numerous rock fragments are on the surface and through the profile. Included are a few small areas that would have been separated as rough gullied land if the total extent had been greater. These areas were formerly Muskingum soils but now consist of a network of gullies extending to bedrock of sandstone and shale. The surface soil and subsoil have been removed from most of them, leaving the bedrock exposed.

Because of the steep slopes and severe erosion, this phase is better adapted to forest than to either permanent pasture or cultivated crops. The included rough gullied land is worthless for agriculture and it is difficult for trees to establish themselves on it.

Muskingum stony fine sandy loam (M3).—This well-drained to excessively drained soil is similar to Muskingum fine sandy loam in profile characteristics but on its surface are stones ranging from one to several feet in diameter that interfere with or prohibit cultivation. Slopes range from 5 to 18 percent. The soil is now largely in timber; only a few acres are in permanent pasture.

Muskingum stony fine sandy loam, eroded steep phase (M4).—Erosion has removed 25 percent or more of the surface soil from this phase. Slopes are greater than 18 percent, and sandstone fragments and boulders on the surface prohibit use of the soil for cultivated crops. Most of the land has been cleared of timber and is now in permanent pasture. It is probably better for forest than for either pasture or cultivated crops. Included are a few uneroded areas still in forest.

Muskingum stony silt loam (M5).—This well drained to excessively drained soil developed on interbedded sandstone, siltstone, and shale of the uplands. It occurs on 5- to 18-percent slopes and is widely scattered throughout the county in association with other Muskingum soils. The profile characteristics are similar to those of Muskingum silt loam, except sandstone rocks of variable size are on the surface in numbers sufficient to interfere seriously with or prohibit cultivation. The stones vary from about 6 inches to several feet in diameter.

About 95 percent of this soil remains in timber. Small isolated areas are in permanent pasture. Because of the large number of boulders, the land is not suitable for tillage and is probably best used for forest.

Muskingum stony silt loam, eroded phase (M6).—Erosion has removed 25 percent or more of the surface soil from this phase. Stones are too numerous on the surface to permit cultivation. Slopes range

from 5 to 18 percent. The soil areas occur in association with Muskingum stony silt loam and are widely scattered through the county. This soil is now idle or in permanent pasture.

Muskingum stony silt loam, very gently sloping phase (M8).—This soil occurs in association with Muskingum stony silt loam and is similar to it in profile characteristics, development, and degree of stoniness. Slopes of this phase, however, are less than 5 percent. Practically all the land supports a growth of mixed hardwoods; only a few small areas are in permanent pasture. Surface stones are too numerous to permit cultivation.

Muskingum stony silt loam, very steep phase (M9).—This phase occurs on slopes greater than 30 percent. It has a profile somewhat similar to that of Muskingum stony silt loam, but the surface and subsoil layers are considerably thinner. Stones on the surface prohibit cultivation. Practically all this soil is in forest; only small open patches are in permanent pasture.

Muskingum stony silt loam, eroded very steep phase (M7).—Erosion has removed 25 percent or more of the surface soil from this phase, and there are occasional gullies. The slopes are greater than 30 percent. The land has been cleared of timber and now supports a growth of povertygrass, broomsedge, bluegrass, white clover, and various kinds of sassafras and sumac. The soil is better adapted to forest than to pasture.

Muskingum-Brooke complex (formerly Westmoreland silty clay loam) (MG).—This land has a complexity of soil conditions. It was called Westmoreland silty clay loam in earlier surveys in the State. It occurs on upland areas where soils are developed on relatively thin interbedded layers, or strata, of sandstone, siltstone, shale, and limestone. The thickness and sequence of the bedrock formations are variable, but limestone is usually a minor constituent. Slopes range from 5 to 18 percent. Surface drainage is good to excessive, and internal drainage is variable, depending upon the bedrock formation.

Washing and creeping of the material down the slope has resulted in a complex mixing, and that part of the complex developed on or below the strata of limestone is only slightly acid to neutral. This is essentially a complex of Muskingum and Brooke soils, together with an integral mixture of materials having characteristics of both these soils. The Muskingum soil profile is described under the Muskingum silt loam type. Brooke soils are developed on limestone and are not extensive enough to be mapped separately in this county.

Profile of Brooke silty clay loam:

0 to 6 inches, brownish-gray to grayish-brown plastic silty clay loam; variable but usually low organic content; slightly acid to neutral.

6 to 14 inches, light brownish-yellow to pale-yellow dense plastic clay breaking into blocky aggregates; plastic when moist, hard when dry; slightly acid to neutral.

14 to 20 inches, pale-yellow or grayish-yellow tough plastic clay; small partly weathered limestone fragments occur in lower part of this layer; neutral to slightly alkaline.

20 inches +, limestone bedrock.

The profile of Brooke silty clay loam varies in color, texture, and thickness of the various layers and in depth to limestone bedrock.

Use and management.—Although practically all this complex has been cleared of timber, only about 15 percent is cultivated. The rest is used for permanent pasture or is left idle. The cultivated areas are usually farmed along with associated soils. Among the crops grown are corn, wheat or oats, and a mixture of clover and timothy. Yields are variable, depending upon the extent and influence of limestone material. Under present management corn yields 34 to 58 bushels an acre; wheat, 19 to 31 bushels; oats, 38 to 47 bushels; and mixed hay, 1.4 to 2.7 tons.

Because of their heavy textures some of the soils making up this complex require special handling and should be cultivated within narrow moisture limits. The soils, especially those that have been decidedly influenced by limestone, are well adapted to permanent pasture. As the reaction of the surface and subsoil is only slightly acid to neutral, it is relatively easy to obtain and maintain good stands of bluegrass and white clover. A few areas are in alfalfa, but the heavy texture of the surface and subsoil of some of the soils in the complex results in some damage to alfalfa plants from heaving.

Muskingum-Brooke complex, eroded phases (formerly Westmoreland silty clay loam, eroded phase) (MH).—The phases in this complex have 5- to 18-percent slopes and occur where 50 percent or more of the surface soil, or all of the surface soil and part of the subsoil, has been removed. Gullies occur on many areas. Except for color of the surface soils, the profiles of these soils are similar to those of the Muskingum-Brooke complex. The profile of the Muskingum soil is described under Muskingum silt loam, eroded phase; that of the Brooke soil is light brownish yellow.

Use and management.—A few areas without gullies are farmed with the uneroded complex, but yields are low. The land is largely in permanent pasture. Areas influenced by limestone have a fair stand of bluegrass and sweetclover, whereas areas of Muskingum silt loam, eroded phase, support a sparse growth of briers, broomsedge, and poverty grass.

Muskingum-Brooke complex, eroded steep phases (formerly Westmoreland silty clay loam, eroded steep phase) (MI).—This complex consists of mixed areas of Muskingum and Brooke soils occurring on slopes of 18 to 30 percent. A large part or all the surface soil has been removed by erosion, and gullies are common. This land is seldom cultivated but is used for permanent pasture or forest. Pasture is of fair to poor quality, and reforestation of most areas is desirable.

Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam) (MIO).—This mixture of soils occurs where interbedded sandstone, noncalcareous and calcareous shale, calcareous red clay shale, and limestone are in such small areas that it is impractical to separate the soils developed on the various formations. The formations are extremely variable in thickness and grade into each other in such a complicated manner that the complex has been established to take care of the resultant soil mixture. Profiles of Muskingum silt loam, Upshur clay, and Brooke silty clay loam are included in this complex, together with numerous intermediate profiles. The relief

is slightly undulating to gently rolling. Slopes range from about 5 to 18 percent, but a few ridge-top areas of less than 5-percent slope have been included. Surface drainage is good to excessive; internal drainage is somewhat variable, depending on the bedrock formation.

Use and management.—About 85 percent of this complex has been cleared of timber and used principally for permanent pasture; about 10 percent is cultivated; the rest is in timber. The growth of pasture is determined largely by the quantity of limestone and calcareous shale present and its quality varies from poor to excellent. The better pastures are on areas where limestone and calcareous shale crops out or immediately below such places where the soil is influenced by these formations.

Among the cultivated crops are corn, wheat, and oats, and a comparatively small acreage of hay. Under present management corn yields 33 to 54 bushels an acre, the actual yield depending upon previous cropping practices, the quantity of commercial fertilizer used, and seasonal conditions. Wheat yields 18 to 30 bushels an acre. Some crop losses occur on the heavier soils of this complex because of frost heaving in winter and early in spring. On areas that have been influenced by limestone and calcareous shale formations fairly good stands of clover and alfalfa can be obtained, but losses are occassionally great because of winterkilling and the heavy texture of the subsoil in some places.

Muskingum-Upshur-Brooke complex, eroded phases (formerly Belmont silty clay loam, eroded phase) (M11).—These phases occur on slopes of 5 to 18 percent and have lost 25 percent or more of their surface soil through erosion. They are associated with the uneroded complex on the uplands in relatively small scattered areas.

In profile characteristics this complex is similar to the complex of uneroded phases, except its surface 6 or 7 inches is low in organic content and includes a part of the subsoil. Tilth is generally poor, and the plant-nutrient supply is low. A few areas are cultivated to corn, wheat or oats, and hay, but yields are low. These soils are better adapted to permanent pasture.

Muskingum-Upshur-Brooke complex, eroded steep phases (formerly Belmont silty clay loam, eroded steep phase) (M12).—Mixtures of Muskingum, Upshur, and Brooke soils occurring on slopes of 18 to 30 percent make up this complex. Erosion has removed 50 percent or more of the surface soil, and there are a few gullies.

Only a small part of the cleared land is used for cultivated crops, which include corn, wheat, and oats. The yields are relatively low. Most of the soil is used for permanent pasture, which is of poor to excellent quality, depending upon the influence of the limestone and calcareous shale.

Philo loam (PA).—This soil of the alluvial flood plains has formed from alluvium washed from upland soils developed on sandstone, siltstone, and shale and from soils on the associated terraces. It is a member of the soil catena that includes the well-drained Pope and the poorly drained Atkins soils.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light brownish-gray friable loam; relatively low organic content; medium to strongly acid.

7 to 20 inches, pale-yellow to light brownish-yellow friable loam to silt loam; medium to strongly acid.
20 inches +, mottled gray, yellow, and brown loam to silty clay loam; below a depth of 20 inches very uniform, usually consisting of alternate layers, variable in thickness, of loam, fine sand, silt, and some clay; medium acid.

The profile varies in texture, color, and thickness of the various layers. Included are small areas having a fine sandy loam surface texture that are underlain by loamy sand or sandy loam material. Some areas that have mottled gray, yellow, and brown subsoil at a depth of about 12 inches have poorer drainage than the typical soil.

Use and management.—Most of Philo loam is subject to flooding, and the crop rotation therefore consists chiefly of corn and soybeans, with small proportions of hay and small grains. A considerable part is in permanent pasture or forest. Under present management corn yields 27 to 54 bushels an acre. The higher yields are obtained during seasons of favorable moisture. Because of the danger of flooding, small grains are not well adapted. Clover and alfalfa produce fair to good yields after enough lime has been applied to neutralize soil acidity. Permanent pastures support a growth of bluegrass, broom-sedge, and white clover.

Philo silt loam (Pb).—This nearly level soil formed from alluvium washed from areas of upland soils developed on sandstone, siltstone, and shale and from soils on the associated terraces. It is a member of the soil catena that includes the well-drained Pope and the poorly drained Atkins soils. Areas occur principally along smaller streams and drainageways, especially those that drain sandstone and shale uplands and slack-water silt and clay terraces. Occasionally, the soil is somewht removed from the channel of the larger streams and is associated with Pope soils. Internal drainage is somewhat restricted in the lower part of the profile.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light brownish-gray friable silt loam; variable but usually relatively low organic content; medium to strongly acid.
7 to 18 inches, pale-yellow to light brownish-yellow heavy silt loam that breaks into medium-sized granules; medium to strongly acid.
18 inches +, mottled gray, yellow, and brown silt loam to silty clay loam, variable in texture and color; usually consists of alternate layers, or stratifications, of silt, clay, and fine sand.

Profile variations are in color, texture, and thickness of the various layers. A few included areas have dark-brown silt loam surface layers that are somewhat higher in organic content. Some of the small areas are somewhat better drained than typical, but mottling occurs below a depth of 25 inches. In the northeastern part of the county and in other scattered areas, the subsoil below a depth of 18 to 20 inches is heavy silty clay or clay. This inclusion occurs where streams have cut through the slack-water terraces of silt and clay and have subsequently deposited silty material of stratified silt and clay.

Use and management.—Approximately 90 percent of Philo silt loam is used for cultivated crops or pasture (pl. 4). The principal crops are corn and hay; oats and soybeans are grown occasionally. Under present management, corn yields 27 to 54 bushels an acre. Higher yields may be obtained if sufficient commercial fertilizer has been used

and weather has been favorable. Under better management oats yield 20 to 30 bushels an acre. The soil is not well suited to small grains because there is danger of flooding. The hay crop is usually a mixture of timothy and clover, but small areas are in alfalfa.

Liming is essential for production of clover and alfalfa. Some areas have been tile-drained, and a few open ditches are in use. Crop rotations and yields depend largely upon the number and frequency of floodings, which vary from year to year and from place to place.

Philo silt loam, high-bottom phase (Pc).—This phase has essentially the same profile as Philo silt loam but is not subject to such frequent flooding. Its occurrence on slightly higher positions in the alluvial flood plains permits a somewhat more diversified system of crop rotation, which includes corn, wheat or oats, soybeans, and hay. Crop yields are comparable to those obtained on Philo silt loam in any given year, but average yields obtained over a period of 10 or more years are somewhat higher because crops are more frequently lost on the lower lying soil.

Pope fine sandy loam (Pd).—Alluvium washed from upland soils developed on sandstone and shale and from soils on associated terrace areas is the material on which this soil developed. It is the well-drained member of the soil catena that includes the moderately well drained Philo and the poorly drained Atkins soils. Areas occur chiefly where coarse-grained sandstone outcrops are extensive, often as narrow intermittent strips along or near the banks of stream channels.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown very friable fine sandy loam; relatively low organic content; medium to strongly acid.

7 inches +, yellowish-brown to brownish-yellow fine sandy loam to fine sand; subsoil texture somewhat variable and may include relatively thin layers of coarse sand and gravel; medium to strongly acid.

The profile varies in the texture of surface soil and subsoil. Included are a few areas with a loamy sand surface texture and others that contain considerable quantities of coarse sand and have gravel on the surface.

Use and management.—The use of Pope fine sandy loam is often governed by the use made of adjacent alluvial soils. Thus, many small areas are cultivated to crops that give unsatisfactory yields. The soil is somewhat droughty because of its porous surface soil and subsoil and therefore its use for crops is often limited. Under present management corn yields 15 to 30 bushes an acre; wheat, 12 to 20 bushels. Much of the area is in permanent pasture or is allowed to remain idle.

Pope loam (Pe).—Stream bottoms throughout the county are occupied by this nearly level soil, which occasionally occurs in relatively large areas. It has developed on alluvium washed from areas or upland soils formed from sandstone, siltstone, and shale and from soils on associated terrace areas. It is the well-drained member of the soil catena that includes the moderately well drained Philo and the poorly drained Atkins soils. Internal drainage is good. The natural vegetation was deciduous trees, principally ash, maple, elm, sycamore, and cottonwood.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown friable loam; relatively low organic content; medium to strongly acid.
7 to 15 inches, yellowish-brown to brownish-yellow loam to heavy loam with thin pockets or bands of fine sandy loam and silt loam; medium to strongly acid.
15 inches +, stratified layers, variable in thickness, of brownish-yellow loam, fine sandy loam, silt loam, sandy clay, and sand, with an occasional layer of gravel; medium acid.

The profile varies in texture and thickness of the various layers. Included are small areas that have an upper subsoil of fine sandy loam.

Use and management.—More than 95 percent of Pope loam has been cleared of forest and is used for crops. Because of flood danger, the principal crops are corn and wheat. The corn yields 30 to 48 bushels an acre; the higher yields are obtained on the more productive areas and when seasons are favorable. The soil is well adapted to wheat, oats, and other small grains, but only small areas are planted to these crops because of the danger of floods. Hay crops include a mixture of timothy, clover, and some alfalfa; a few areas are in clover or alfalfa. Enough lime to neutralize acidity must be applied before alfalfa and clover can be grown successfully. Soybeans, more important in the crop rotation than formerly, are well adapted to this soil because seeding takes place after the spring and early summer floods.

Pope loam, high-bottom phase (PF).—This phase has essentially the same profile characteristics as Pope loam but occupies a slightly higher position in the flood plains. Practically all of it is cultivated to corn, wheat or oats, and clover. Crop yields are about equal to those on Pope loam. The slightly higher position of this soil permits use of a somewhat more diversified rotation, however, and there is less loss from flooding.

Pope silt loam (PG).—The parent material for this nearly level soil is alluvium washed from areas of upland soils developed on sandstone, siltstone, and shale and from associated soils on terraces. It is the well-drained member of the soil catena that includes the moderately well drained Philo and the poorly drained Atkins soils. Internal drainage is good. The larger areas occur principally along Stillwater and Sugar Creeks and to a lesser extent along the many drainageways of the county, occasionally as relatively narrow bands that are adjacent to the larger streams and associated with Philo soils. The natural vegetation was deciduous trees, principally ash, elm, sycamore, and cottonwood.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown smooth friable silt loam; relatively low organic content; medium to strongly acid.
7 to 30 inches, yellowish-brown to brownish-yellow friable heavy silt loam to silty clay loam; medium to strongly acid.
30 inches +, stratified layers of brownish-yellow silt, fine sand, sand, and some gravel; arrangement and thickness of these layers vary.

Profile variations are in color, texture, and thickness of the various layers. A few areas have a dark grayish-brown surface soil higher in organic content than typical. Some small areas have a silty clay loam surface texture.

Use and management.—About 90 percent of Pope silt loam has been cleared of timber and is now used for cultivated crops or permanent pasture. Because of danger of flooding, rotations consist principally of corn and hay, though an occasional crop of oats or soybeans is grown. Under present management corn yields 33 to 60 bushels an acre, the higher yields being obtained during seasons of favorable weather where better management practices are followed. The soil is well adapted to small grains, but danger of flooding discourages growing them. The hay is principally a mixture of timothy and red and alsike clovers, but a few areas are in alfalfa. Lime enough to correct acidity must be applied for the successful growing of legumes. Permanent pasture supports a mixture of bluegrass and white clover. Narrow bands of forested areas are adjacent to stream channels.

Pope silt loam, high-bottom phase (PH).—This phase occurs at a slightly higher position than Pope silt loam and is flooded less frequently. The profiles of the two soils are essentially the same, but this phase has some subsoil development. The crop rotation consists of corn, wheat or oats, and hay, with an occasional crop of soybeans. Crop yields average about the same as those on Pope silt loam, but losses caused by flooding are considerably less.

Rarden silt loam (RA).—Shale or clay shale varying from olive drab or pale green to pale red is the material on which this soil developed. Areas are mapped in the uplands in close association with Muskingum silt loam. The relief ranges from 5 to about 18 percent. Surface drainage is good to slightly excessive; internal drainage is somewhat restricted in the lower subsoil. Characteristic of this soil, and the principal difference between it and Keene silt loam, is the reddish-brown color of the upper subsoil and the subsoil layers.

Profile in cultivated areas:

0 to 6 inches, light grayish-brown to light yellowish-brown friable silt loam; low organic content; medium to strongly acid.

6 to 12 inches, yellowish-brown to brownish-yellow heavy silt loam that breaks into medium-sized granules; medium to strongly acid.

12 to 16 inches, light brownish-yellow silty clay loam with reddish-brown streaks and thin seams of light gray; breaks into medium-sized angular aggregates that are slightly plastic when moist and hard when dry; medium to strongly acid.

16 to 30 inches, reddish-brown to brownish-yellow heavy plastic silty clay to clay showing many blotches of gray and brownish red; reddish coloration becomes more pronounced with depth; material has mottled appearance when broken out, breaking into blocky aggregates that are plastic when moist and hard when dry; medium to strongly acid.

30 inches +, olive-drab or greenish-gray noncalcareous clay shale; contains a few partly weathered sandstone fragments.

The profile may vary from that described in color, texture, and thickness of the various layers and in depth to the clay shale bedrock. Included are a few small areas that have a heavy silt loam to silty clay loam surface soil, part of which has been removed by erosion. These areas would have been included with the eroded phase if they had been of sufficient size. In these included areas the color of the subsoil and the degree of mottling vary.

Use and management.—Practically all areas of Rarden silt loam have been cleared of timber and cultivated or used for permanent pasture. At present, however, only about 5 percent of the land is cul-

tivated. Corn, wheat or oats, and hay are the main crops. Under present management corn yields 25 to 48 bushels an acre; oats, 25 to 40 bushels; and hay crops, consisting of a mixture of timothy and clover, 1 to 1.7 tons. This soil is frequently farmed with associated smoother phases of Muskingum soils. Its use is largely governed by the size of individual areas and the extent of the areas with which it is associated.

The soil is naturally low in organic matter and plant nutrients. To retard erosion and maintain crop yields, the crop rotation should consist predominantly of small-grain and hay crops. The larger areas are in permanent pasture of fair to poor quality. Use of sufficient lime and commercial fertilizer and control of weeds are essential if the livestock-carrying capacity of pasture is to be maintained or increased. A few areas of this land remain in forest.

Rarden silt loam, eroded phase (RB).—This upland soil occurs on slopes of 5 to 18 percent, and 25 to 75 percent of its surface soil has been removed by erosion. The surface soil, to a depth of 6 or 7 inches, is light grayish-brown to reddish-brown heavy silt loam to silty clay loam, extremely low in organic content and plant nutrients. Tilth is poor; the surface soil cakes and puddles easily under cultivation. The rest of the profile is similar to that of Rarden silt loam, except the various layers are somewhat thinner and the depth to clay shale bedrock is less.

Included are areas, marked with the letters "SG," that would have been separated as the severely eroded phase if the total extent has been larger. Much of the surface soil, or all of the surface soil and part of the subsoil, of this inclusion has been removed by erosion. The surface 6 to 7 inches of this inclusion is reddish-brown to light yellowish-brown heavy silt loam to silty clay loam or silty clay that is low in organic content and plant nutrients.

Use and management.—All areas of Rarden silt loam, eroded phase, have been cleared of timber in the past and have been either cultivated or used for permanent pasture. Lack of erosion control has resulted in the loss of a large part of the organic matter and plant nutrients, and therefore crop yields are materially lower than those obtained on Rarden silt loam. The two soils and those associated with them are cropped in about the same way. Corn, oats, and hay, including clover and timothy, are grown. A few areas are planted to soybeans and wheat. Permanent pasture, fair to poor in quality, usually consists predominantly of poverty grass and broomsedge, with smaller proportions of bluegrass and white clover.

A pasture-improvement program including use of sufficient lime and commercial fertilizer and the control of weeds is essential. These practices have been followed by a few farmers but are not in general use. A few of the more severely eroded areas are probably better for forest than either pasture or cultivated crops.

The included severely eroded areas have all been cleared and used for cultivated crops or permanent pasture, but only a few of them are now cultivated. Yields are extremely low, and the land is largely idle or in poor quality pasture.

Rarden silt loam, very gently sloping phase (Rc).—This phase occurs on 0- to 5-percent slopes and occupies the smoother ridge tops

in the uplands. It is closely associated with the other phases of Rarden silt loam and with Muskingum silt loam. Surface drainage is fair to good, but internal drainage is somewhat restricted in the lower part of the subsoil. The profile characteristics are similar to those of Rarden silt loam, except that the depth to clay shale bedrock is usually slightly greater and the various layers are thicker.

Included with this soil are some eroded areas where more than 25 percent of the surface soil has been removed by erosion. Here, the surface soil, to a depth of 6 or 7 inches, is light brownish-gray to yellowish-brown heavy silt loam to silty clay loam that is low in organic content. Tilth for these included areas is poor, and the surface bakes and puddles to some extent under cultivation.

Use and management.—Much of Rarden silt loam, very gently sloping phase, is cultivated to corn, wheat or oats, and hay. Crop yields are equal to or slightly greater than those obtained on Rarden silt loam. This mildly sloping soil is not so susceptible to erosion as Rarden silt loam. Its use is governed largely by its area and by the extent of the associated soils. Where it occurs on the ridge tops as long relatively narrow areas associated with the steep Muskingum soils, it is usually left in forest or is in permanent pasture. Where the areas are of sufficient size to cultivate, they are better adapted to crops. Only a small part of the included eroded areas are cultivated to general farm crops, and yields are somewhat lower than from the uneroded areas. These inclusions are mostly in medium- to low-grade permanent pasture or are left idle.

Riverwash (RD).—This mixture of gravel, sand, and silt has accumulated in small bands in the channel of the Tuscarawas River or in narrow bands along the banks of the river channel. Most areas are not stable, and each flooding either deposits material or washes away part of that already deposited. This land has practically no agricultural value. A few areas are devoid of vegetation, but some maintain a scant growth of willows, weeds, and briers.

Seepy land (Muskingum and Keene soil materials) (SA).—Seeps or springs have saturated this material and keep it permanently wet. The areas are scattered throughout the upland in association with sloping Muskingum and Keene soils. A few of the places have been drained artificially by tiling the springs or seepage spots, but generally they are not cultivated and are in permanent pasture or forest.

Tilsit silt loam (TA).—This nearly level to very gently sloping soil has a slope range of 0 to about 5 percent. It occupies upland areas and usually occurs as long relatively narrow strips in the middle of the broader ridge tops, with Wellston soils on either side and Muskingum soils occupying the sloping areas. Bedrock consists of stratified siltstone, sandstone, and shale. Surface drainage is fair to good; internal drainage is somewhat restricted in the lower subsoil. The native vegetation consisted of deciduous trees, including oak, hickory, ash, elm, and maple.

Profile in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown smooth friable silt loam; relatively low organic content; medium to strongly acid. (Surface 2 or 3 inches in wooded areas is dark grayish-brown and has a relatively high content of organic matter.)

7 to 15 inches, light brownish-yellow to pale-yellow friable heavy silt loam; breaks into coarse granules or small subangular aggregates easily crushed when moist; moisture and plant roots penetrate this material easily; medium to strongly acid.
15 to 24 inches, pale-yellow heavy silt loam to silty clay loam; breaks into medium-sized subangular aggregates; some gray and brown mottling in lower part; medium to strongly acid.
24 to 45 inches, mottled gray, yellow, and brown heavy silt loam to silty clay loam; pervious to moisture movements and to plant roots where the heavy silt loam texture is encountered but somewhat impervious where the silty clay loam texture occurs; contains a few small partly weathered sandstone and shale fragments in lower part.
45 inches +, interbedded sandstone, siltstone, and shale formations.

Profile variations are in color, thickness, and texture (except the surface texture) of the various layers and in depth to bedrock. Where this soil developed predominantly on siltstone and shale materials, the lower subsoil is silty clay loam to silty clay that develops siltpan or claypan characteristics. Here, the subsoil is somewhat more impervious to moisture and plant roots than in areas where it developed on sandstone. The depth to underlying bedrock varies from 30 to 50 inches or more.

Use and management.—Practically all of Tilsit silt loam has been cleared of forest and is now in crops. The crop rotation consists mainly of corn, wheat or oats, and hay, though small acreages of soybeans are grown. The soil is naturally low in plant nutrients and organic matter. Constant replenishment of these elements is necessary for the maintenance and improvement of crop yields. Corn yields 24 to 48 bushels an acre; wheat, 12 to 23 bushels.

Commercial fertilizer is commonly applied to both corn and wheat, though the quantity and analyses vary somewhat. The hay crops are timothy or clover grown alone or both of these mixed with some alsike clover. The surface and subsoil are medium to strongly acid; sufficient lime to neutralize acidity must be applied before good stands of legumes can be obtained. Under good management this soil will produce satisfactory yields of all general crops.

Tuscarawas silt loam (Tb).—Areas of this soil have developed along the lower slopes, at the heads of small drainageways, and on outwash fans extending from mouths of gullies or steep ravines. The material is washed chiefly from the associated Muskingum or Keene soils of the uplands. Slopes are usually less than 12 percent, but a few areas in the western part of the county are steeper. This soil differs from the colluvial phase of Muskingum silt loam in having a better developed subsoil and greater depth to bedrock.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable silt loam; relatively low organic content; medium to strongly acid.
7 to 18 inches, light brownish-yellow to light yellowish-brown heavy friable silt loam to silty clay loam; slightly compact in place; usually free of rock fragments; medium to strongly acid.
18 to 40 inches, light yellowish-brown heavy silt loam to silty clay loam, mottled and streaked with light gray and brown; lower part variable in texture and color, often showing thin seams or layers of contrasting texture.
40 inches +, bedrock of sandstone, siltstone, and shale.

The profile varies in color, texture, and thickness of the various layers. A few areas have many small sandstone and shale fragments on the surface and throughout.

Use and management.—Most of Tuscarawas silt loam is in permanent pasture; about 10 percent is cultivated, and about 15 percent is in forest. Many areas are used as building sites. The permanent pasture is a mixture of poverty grass, broomsedge, native weeds, and a small proportion of bluegrass and white clover. The main cultivated crops are corn, wheat, oats, and a mixture of timothy and clover. Under better management corn yields 25 to 45 bushels an acre; wheat, 12 to 23; and oats, 20 to 35.

Tuscarawas silt loam, eroded phase (Tc).—Slopes for this phase range from 5 to about 20 percent; 50 percent or more of the surface soil has been removed by erosion, and there are occasional gullies. The surface soil, 6 or 7 inches deep, is light yellowish-brown to light brownish-yellow heavy silt loam to light silty clay loam that is very low in organic content. The rest of the profile is similar to that of Tuscarawas silt loam. Areas occur in close association with the uneroded silt loam, between soils developed on slack-water terraces and upland areas of Muskingum soils.

Use and management.—Tilth is poorer than for Tuscarawas silt loam, and extremely careful management is necessary to prevent further erosion. The soil is farmed with associated soils, and crop rotations include corn, wheat or oats, hay crops, and occasionally a crop of soybeans. Yields are materially below those obtained on the uneroded soil. A few areas are used for permanent pasture of fair to poor quality. Use of sufficient lime and commercial fertilizer and control of weeds are necessary for increasing the carrying capacity of pastures.

Tyler silt loam (Td).—This nearly level soil developed on stratified slack-water silts and clays. It is a member of the soil catena that also includes the well-drained Holston and the moderately well drained Monogahela. It occurs on slack-water terraces in the valleys of the numerous streams and rivers that were flooded during the last glaciation. Surface drainage is slow, and internal drainage is imperfect. Artificial drainage is necessary for the successful growing of cultivated crops. This is usually accomplished with title drains or, in some instances, with open ditches. The native vegetation is deciduous trees, pricipally oak, maple, ash, and elm.

Profile in cultivated areas:

0 to 7 inches, light gray to light brownish-gray smooth friable silt loam; very low organic content. (Surface 2 or 3 inches in wooded areas is dark brownish gray and relatively higher in content of organic matter.)

7 to 14 inches, mottled gray, yellow, and brown heavy silt loam; breaks into medium- to large-sized granular aggregates easily crushed into small aggregates; medium to strongly acid.

14 to 35 inches, mottled light-gray and yellow silty clay loam; breaks into medium-sized subangular or blocky aggregates, slightly plastic when moist and hard when dry; somewhat impervious to moisture movement and to plant roots; medium to strongly acid.

35 inches +, laminated and stratified layers of gray and pale-yellow silt and clay extending downward to depths of several feet; occasional thin layer of fine sand or gravel; thickness, sequence, and presence of layers extremely variable; medium to strongly acid.

The profile varies in color, thickness, and texture of the various layers. In some areas the surface soil is very light gray and contains many small, firm, rounded iron concretions. Where the soil grades into

Chenango and other soils developed on outwash material, the surface and subsoil layers contain variable quantities of small rounded gravel, and the underlying material contains more gravel and sand than the typical profile. In a few areas, where the surface 7 to 10 inches lies directly on heavy plastic clay, natural drainage is somewhat poorer than typical. A few included areas have lost 50 percent or more of the surface soil through erosion. In these areas relief is generally somewhat more sloping but usually less than 8 percent. The 6- to 7-inch surface soil in eroded areas is light brownish-gray heavy silt loam to silty clay loam, faintly mottled with yellow and brown.

Use and management.—About 50 percent of Tyler silt loam is planted to cultivated crops; the rest is used for forest and permanent pasture.

In the rotation system used corn, wheat or oats, hay and an occasional crop of soybeans or other field crops are grown. The soil should be drained artificially before being used for cultivated crops. Most of the areas have sufficient artificial drainage for cultivation, but a few need more adequate drainage. Corn yields 15 to 36 bushels an acre, the actual yield depending largely upon weather, adequacy of drainage, use of commercial fertilizer, and state of soil fertility. Small grains are not well adapted. Fall-sown small grains, as wheat and rye, are occasionally severely damaged by alternate freezing and thawing and by heaving. Wheat yields 10 to 15 bushels an acre; oats, 18 to 30 bushels. The hay crops are a mixture of timothy and red clover with some alfalfa, or any of these three grown alone. The included eroded areas are used largely for corn, wheat or oats, and hay. The rotation is governed by the associated soils. The organic content as well as the plant-nutrient supply for included areas is lower than in the normal soil, and crop yields are naturally somewhat lower.

Sufficient lime must be applied to this soil to neutralize the acidity before clover and alfalfa can be grown successfully. The soil is naturally low in organic matter and plant nutrients, and in any management program all available organic matter should be turned under and sufficient commercial fertilizer and lime applied. Permanent pastures support a mixture of poverty grass, broomsedge, and bluegrass, with the bluegrass usually a minor constitutent. Most of the permanent pastures can be improved by using commercial fertilizer relatively high in phosphate and by controlling weeds.

Tyler silty clay loam (TE).—This nearly level soil developed on stratified or interbedded slack-water deposits of silt and clay. It is a member of the soil catena that includes the well-drained Holston and the moderately well drained Monongahela soils. Surface drainage is fair to slow, and internal drainage is imperfect.

Profile in cultivated areas:

0 to 7 inches, light gray to light brownish-gray slightly plastic silty clay loam; very low organic content; puddles under improper cultivation; medium to strongly acid.

7 to 12 inches, mottled light gray, yellow, and brown compact heavy silty clay loam to silty clay; breaks into medium-sized blocky aggregates that are plastic when moist and hard when dry; medium to strongly acid.

12 to 30 inches, highly mottled gray, yellow, and brown plastic clay; breaks into medium to large blocky aggregates that are plastic when moist and hard when dry; somewhat impervious to moisture movement and plant roots; medium to strongly acid.

30 inches +, stratified layers of gray and pale-yellow clay and silt with relatively thin lenses or bands of fine sand; extends downward to a depth of several feet.

The profile varies in color, texture, and thickness of its various layers. Where Tyler silty clay loam grades into Tyler silt loam, the surface texture is somewhat lighter and approaches a silt loam. Included are small areas where 50 percent or more of the surface soil has been removed by erosion. The surface layer of these areas extends to a depth of 6 or 7 inches; it is light brownish-gray to gray heavy silty clay loam to silty clay, faintly mottled with yellow and brown.

Use and management.—Most of Tyler silty clay loam is used for permanent pasture or hay. Small areas associated with Tyler silt loam and Monongahela silt loam are cultivated in about the same as the associated soils but the crop yields are less. The cultivated crops include corn, wheat, oats, and hay. Corn yields 15 to 30 bushels an acre, the yield in any given year depending largely on weather, adequacy of drainage, and kind of management. This soil is not well adapted to small grains. Wheat is frequently winterkilled by alternate freezing and thawing and by drowning out. The hay crops are mixtures of timothy and clover, or occasionally alfalfa. Neither clover nor alfalfa is well adapted, for the surface soil and subsoil are strongly acid, drainage is imperfect, and the subsoil is heavy and plastic. Tilth is not so good on the included eroded areas, and crop yields are materially lower.

Sufficient lime to neutralize acidity must be applied before alfalfa and clover can be grown successfully. These crops are occasionally damaged in winter and early in spring by heaving or by drowning out. Timothy is probably better suited than either alfalfa or clover. The permanent pasture is a mixture of poverty grass, broomsedge, and bluegrass. Most pastures are poor and could be greatly improved by adequate artificial drainage and the application of sufficient commercial fertilizer and lime.

Upshur-Muskingum complex (formerly Meigs silty clay loam) (UA).—A mixture of Upshur and Muskingum soils occurring on the uplands is the material for this complex, but some soils developed on resultant mixture of different materials are unlike either Upshur or Muskingum soils. The bedrock formations contain relatively thin stratified beds or layers of sandstone, siltstone, shale, clay shale, and green or red soft calcareous clay shale. Surface drainage is excessive; internal drainage is good to imperfect.

The soil profile varies within short horizontal distances according to variation in the rock formations from which its materials are derived. There is intermingling of materials on the hillsides caused by washing and creep, with corresponding variations in depth to bedrock. The Upshur soils, developed on calcareous green and red soft clay shales, are not extensive enough in this county to be mapped separately.

Profile of Upshur silty clay loam:

0 to 7 inches, light-brown or light reddish-brown heavy silty clay loam; relatively low organic content; medium to slightly acid.

7 to 22 inches, reddish-brown to brownish-red plastic smooth clay; slightly acid to neutral.

22 inches +, brownish-red to green soft calcareous clay shale.

The profile of the Upshur soil varies in color, texture, and thickness of its various layers. A profile developed on sandstone, siltstone, and shale is similar to that given for Muskingum silt loam elsewhere in this report.

Use and management.—Most of this complex has been cleared of timber but is now idle or in permanent pasture. The quality of pasture varies within short distances—that on soils developed from calcareous clay shale has a high proportion of bluegrass and white clover, whereas that on soils developed on sandstone, siltstone, and shale is of medium to low quality and consists chiefly of broomsedge and poverty grass with a small proportion of bluegrass. Idle land supports briers, sumac, sassafras, various weeds, and a small proportion of bluegrass and white clover.

Upshur-Muskingum complex, eroded phases (formerly Meigs silty clay loam, eroded phase) (UB).—This complex differs from the uneroded Upshur-Muskingum phases in that most of the surface soil, or all the surface soil and part of the subsoil has been removed by erosion. Gullies are numerous in many areas and often extend down to the bedrock.

Little attempt is made to cultivate these seriously eroded soils. A few areas are in permanent pasture, but most of the land formerly cultivated or in permanent pasture is now abandoned and supporting briers, sassafras, sumac, and weeds. This land is better for forest than cultivated crops or permanent pasture.

Wayland silt loam (WA).—This poorly drained alluvial soil is associated with the Chagrin and Lobdell soils. Its alluvium washed chiefly from soils of the glaciated areas north of the county. Areas are mainly in depressed parts of larger stream bottoms, well back from the stream channel. The natural vegetation consisted of swamp oak, soft maple, willow, and sycamore.

Profile in cultivated areas:

0 to 7 inches, gray friable silt loam with a few brown rounded hard iron concretions; slightly to medium acid.

7 to 15 inches, light-gray friable silt loam mottled with yellow and brown; intensity of mottling increases with depth; slightly to medium acid.

15 inches +, mottled gray, yellow, and brown heavy silt loam to silty clay loam; slightly to medium acid.

Layers of variable thickness of silt, clay, and sand occur in the lower subsoil. Some areas have a dark-gray surface soil relatively high in organic content. A few of the areas that occupy slightly elevated positions in the flood plains can be more readily drained. Some included areas have silty clay loam surface soil and silty clay loam to clay subsoil. Also included are small areas with a fine sandy loam surface texture.

Use and management.—Practically all of Wayland silt loam has been cleared and cultivated. At present about 40 percent is in permanent pasture. The cultivated areas are used chiefly for corn and hay. Yields vary with the adequacy of drainage, but on the better drained areas and under better management practices corn produces 18 to 40 bushels an acre. The hay crop is mixed timothy and alsike, for the soil is not well suited to alfalfa or red clover. Where the soil occurs in long narrow areas, it is probably best used for permanent pasture.

The crop yields on the included higher lying areas are slightly greater, and the hazard of damage by flooding is not so great. Cultivated crops are produced on a few areas of the included silty clay loam soil, but adequate artificial drainage is difficult to obtain and most of this inclusion is therefore in permanent pasture. Corn yields are fair; small-grain crops are not adapted.

Wellston silt loam (WB).—Interbedded sandstone, siltstone, and shale is the formation from which this soil developed. It occurs on broader ridge tops having a gradient of less than 5 percent. Occasionally it occupies the smoother parts of the ridges or occurs as the outer fringe of the broader ridge tops. Surface drainage is good, or somewhat excessive on a few areas. Internal drainage is good. The natural vegetation was deciduous forest, principally oak and hickory.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown smooth friable silt loam; relatively low organic content; medium to strongly acid.
7 to 14 inches, brownish-yellow to yellowish-brown friable medium granular heavy silt loam; medium to strongly acid.
14 to 25 inches, brownish-yellow to yellowish-brown moderately compact heavy silt loam to silty clay loam; breaks into coarse granular or small subangular aggregates; medium to strongly acid.
25 to 36 inches, light yellowish-brown to brownish-yellow silt loam somewhat less compact than layer above; a few light-gray and brown mottles and streaks in the lower part; various-sized partly weathered sandstone and shale rock fragments throughout layer but principally in lower part; medium acid.
36 inches +, interbedded sandstone, siltstone, and shale bedrock.

Thickness, color, and texture (except the surface texture) of the various layers may vary from that in the profile just described. Where the soil is developed principally on siltstone and clay shale, its lower subsoil is somewhat more compact and heavier textured than typical and the depth to underlying bedrock is usually somewhat greater.

Use and management.—Most of Wellston silt loam is either cultivated or in permanent pasture. Its use is often influenced by the associated soils, and the rotation is made up for the most part of corn, wheat or oats, and hay. A small acreage is planted to soybeans and special field crops; a still smaller acreage is in special truck crops or is used as garden sites. Erosion is usually not a major problem.

Under present management corn yields 33 to 57 bushels an acre, and wheat 15 to 27 bushels. Oats are not so well adapted as wheat, and their acreage is relatively small. Yields of oats under present management, range from 30 to about 45 bushels an acre. The hay crops are commonly clover, timothy, and some alsike mixed, but clover or timothy are sometimes grown alone. A few areas are in alfalfa.

Sufficient lime to neutralize soil acidity must be applied before clover and alfalfa can be grown successfully. This soil is naturally low in organic matter and plant nutrients. Any management program and crop-rotation system should include the turning under of all available organic material and the application of enough commercial fertilizer to meet crop requirements. The permanent pasture is a mixture of bluegrass, broomsedge, and various native weeds. Most pasture would be greatly improved by controlling weeds and applying

liberal quantities of a commercial fertilizer relatively high in phosphorus.

Wellston silt loam, shallow phase (WD).—The surface soil and upper subsoil of this phase are similar to those of Wellston silt loam, but the lower subsoil generally contains more partly weathered rock fragments. Depth to bedrock is also considerably less, the average depth being about 20 to 25 inches. A few areas have many small sandstone and shale fragments on the surface and throughout the profile. This soil represents a transition between Wellston silt loam and Muskingum silt loam. Areas lie on the smoother parts of the ridge tops. The soil is somewhat droughty, especially where the bedrock lies at a shallow depth.

Use and management.—About 15 percent of this phase is in forest; the rest is about equally divided among permanent pasture, idle land, and cultivated land. Permanent pasture usually consist mainly of broomsedge, with small quantities of bluegrass and white clover. Idle land includes areas once cultivated but now grown up to briers, small shrubs, and weeds. The principal crops are corn, wheat, and a mixture of timothy and clover. Yields are somewhat lower than those obtained on Wellston silt loam.

Wellston silt loam, eroded shallow phase (WC).—Erosion has removed 25 percent or more of the surface soil from this phase. The present surface layer is light brownish-yellow to yellowish-brown heavy silt loam, extremely low in organic content. The rest of the profile is essentially the same as that of the shallow phase.

Use and management.—All of this phase has been cleared of timber and has either been cultivated or used for permanent pasture. Areas now cultivated are cropped to corn, wheat, and hay, but yields are somewhat lower than those obtained on the shallow phase. Tilth is not so favorable as for the shallow phase. The growth in pastures is a mixture of broomsedge and poverty grass, with smaller proportions of bluegrass and white clover. The pastures can be materially improved by adding sufficient lime and commercial fertilizer and by controlling weeds.

Wellston silt loam, sloping phase (WE).—This phase occurs on 5- to 12-percent slopes. The profile is about the same as that of Wellston silt loam, except that the depth to bedrock is usually somewhat less. Included are some areas from which 50 percent or more of the surface soil, or all the surface soil and part of the subsoil, has been removed by erosion. Here the surface 6 or 7 inches is light brownish-yellow to yellowish-brown heavy silt loam, low in organic content.

Use and management.—This land is used for permanent pasture and cultivated crops. Yields are somewhat lower than those obtained on Wellston silt loam. Owing to its more sloping relief, it is more susceptible to injury from erosion than is the silt loam, and erosion control is essential to prevent washing away of the surface soil. Areas of the included eroded phase have been cleared and cultivated or used for permanent pasture. On this the chief crops are corn, wheat, and hay, and yields are somewhat lower than those obtained on the typical sloping phase. Much of the pasture on this inclusion has a low livestock-carrying capacity.

Wooster silt loam (WF).—Glacial till, largely sandstone material with a small proportion of shale and yet smaller proportion of lime-

stone and igneous rocks, is the parent material for this soil. It occurs on undulating to gently sloping relief and is associated with Canfield and Hornell soils in the extreme northwestern part of the county. It is a member of the soil catena that includes the moderately well drained Canfield soils. Both surface and internal drainage are good. Erosion becomes a hazard on some of the more sloping areas. The native vegetation consisted of deciduous trees, including oak, hickory, maple, ash, and elm.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable silt loam; relatively low organic content; variable numbers of partly weathered sandstone fragments are on the surface and through the layer but not enough to interfere with cultivation; medium to strongly acid.

7 to 16 inches, light-brown to yellowish-brown friable gritty silt loam to heavy silt loam; contains many small partly weathered sandstone fragments; medium to strongly acid.

16 to 30 inches, yellowish-brown to brownish-yellow heavy silt loam; contains an increasing quantity of sandstone fragments and some shale medium to strongly acid.

30 inches +, brownish-yellow to light brownish-gray friable gritty loam or silt loam; contains a large quantity of sandstone rock fragments that continue downward several feet; medium to strongly acid in the upper part, neutral to slightly alkaline below a depth of 10 feet.

The profile may vary from that described in color, texture, and thickness of its various layers. The quantity of sandstone fragments on the surface and throughout the profile is variable. The depth to underlying sandstone and shale bedrock varies; in a few areas bedrock is less than 36 inches from the surface. Included are some areas where 50 percent or more of the surface soil has been removed by erosion. Here the surface 5 to 7 inches is light yellowish-brown heavy silt loam that is extremely low in organic content and plant nutrients.

Use and management.—Most of Wooster silt loam is planted to farm crops. The rotation consists mainly of corn, wheat or oats, and hay, though some alfalfa, other field crops, and an occasional crop of potatoes are grown. This soil is naturally low in organic matter and plant nutrients but responds to good management. The moisture relations meet the requirements of most crops grown.

Corn usually follows hay in the rotation and yields 35 to 60 bushels or more to the acre. It is common to apply 150 to 250 pounds of commercial fertilizer an acre for corn, and, under better management, yields may be as high as 70 bushels. Wheat, which usually follows corn or soybeans in the rotation, yields 24 to 35 bushels or more an acre. From 150 to 250 pounds of commercial fertilizer is usually applied for wheat. Oats follow corn, soybeans, or wheat in the rotation, or sometimes take the place of wheat. Little commercial fertilizer is used for oats; they yield 38 to 45 bushels an acre.

The hay crops are mixtures of timothy, clover, alsike, and alfalfa, or any of these grown alone. Sufficient lime to neutralize acidity must be applied before legumes will grow successfully. Soybeans, an increasingly important crop, are usually planted to follow wheat or are grown on areas where hay crops have failed. Yields range from 15 to 30 bushels an acre. Potatoes are well adapted, and where soil areas are large enough, as in other parts of Ohio, large acreages are planted. Good stands of bluegrass pasture can be obtained by using sufficient lime to correct acidity and a commercial fertilizer relatively

high in phosphorus. Crop yields on the included eroded areas are materially lower than those obtained on the typical soil.

Wooster silt loam, gently undulating phase (WG).—Except for having various layers usually somewhat thinner, this soil is similar to Wooster silt loam in profile characteristics. Slopes are less than 5 percent; erosion is therefore not serious. All the land has been cleared of timber and is now used for farm crops that produce somewhat lower yields than on Wooster silt loam.

Zaleski silt loam (ZA).—Narrow areas of this soil occur between Muskingum or Keene soils of the upland and Monongahela or Tyler soils of the terraces. The soil developed on colluvium washed or sloughed from upland areas of Muskingum and Keene soils and deposited on terraces of slack-water silts and clays. The colluvial deposit is 18 to 36 inches thick and varies with the type of upland formation. The relief is gently sloping to sloping, and surface drainage is good to slightly excessive on the more sloping areas. Internal drainage is somewhat restricted in the lower subsoil.

Profile in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable silt loam; relatively low organic content; variable quantity of small partly weathered sandstone and shale fragments on the surface and through the layer; medium to strongly acid.

7 to 18 inches, pale-yellow to light brownish-yellow slightly compact heavy silt loam; medium to strongly acid.

18 to 30 inches, mottled gray, yellow, and brown heavy silt loam to silty clay loam; breaks into medium-sized subangular aggregates; medium to strongly acid.

30 inches +, light-yellow, gray, and brown interbedded layers of clay, silt and some sand; material extends downward to a depth of several feet and represents the slack-water terrace deposits; medium to strongly acid.

The profile varies in color, texture, and thickness of the various layers and in depth to interbedded silt and clay. A few areas that receive colluvium from Muskingum fine sandy loam have a somewhat lighter textured surface soil. The quantity of the rock fragments on the surface and throughout the profile is variable but usually not sufficient to interfere with cultivation.

Use and management.—Practically all of Zaleski silt loam is cleared and used for permanent pasture, cultivated crops, or farmstead sites. Its use and the crops grown are usually governed by the size of the individual areas and by the associated soils. The crop rotation includes corn, wheat, and hay. Under present management corn yields 26 to 57 bushels an acre; wheat, 14 to 27 bushels. The hay crops are a mixture of timothy and clover. Permanent pasture consists mainly of poverty grass and broomsedge, with some bluegrass.

USE, MANAGEMENT, AND PRODUCTIVITY OF THE SOILS OF TUSCARAWAS COUNTY

SOIL USES AND AGRICULTURAL METHODS[7]

On the basis of their characteristics, the soils of Tuscarawas County can be placed in five groups, each of which presents its own management problems. These groups are (1) soils of the uplands developed

[7] By Earl Jones, extension agronomist, Ohio State University, and G. W. Conrey, Ohio Agricultural Experiment Station.

from sandstone, siltstone, and shale materials, (2) soils of the uplands developed on glacial till derived from sandstone, siltstone, and shale, (3) soils of the uplands developed from limestone, sandstone, siltstone, and shale materials, (4) soils developed from alluvial materials on terraces, and (5) soils developed from recent alluvial material on stream flood plains. Use and management for the soils in each of these five groups are discussed in the following pages.

USE AND MANAGEMENT OF SOILS OF UPLANDS

The soils of the uplands occur on gently rolling to steep broken land. Their best use is closely related to slope. Many steep slopes have in the past been used for cultivated crops and consequently are seriously eroded. As a general rule, fields with slopes of 18 percent or more now in cultivation should be used mainly for bluegrass pasture or for alfalfa mixed with other forage plants. Areas with slopes of 35 percent or more that are now in permanent pasture should be reforested. Rotation cropping is best for the gently rolling areas. Regardless of slope, severely eroded land generally cannot be made to yield a profitable crop. For this reason, land that has lost 50 percent or more of the surface soil should be used for pasture that can be rejuvenated with alfalfa mixtures or sweetclover. Where the soil is entirely removed to plow depth or below the land should be considered potentially useful for forest. Badly gullied areas should be planted to trees.

Soils of the uplands are in these groups: (1) Soils of uplands developed from sandstone, siltstone, and shale materials; (2) soils of uplands developed on glacial till derived from sandstone, siltstone, and shale materials; and (3) soils of uplands developed from limestone, sandstone, siltstone, and shale materials.

GROUP 1. SOILS OF UPLANDS DEVELOPED FROM SANDSTONE, SILTSTONE, AND SHALE MATERIALS

Most of the soils of the uplands developed from sandstone, siltstone, and shale materials occupy rolling areas. The following soils have slopes less than 18 percent, are not seriously eroded, and can be considered suitable for rotated crops.

Elfort silty clay loam
Elfort silty clay loam, eroded phase
Keene silt loam
Keene silt loam, eroded phase
Keene silt loam, eroded very gently sloping phase
Keene silt loam, very gently sloping phase
Muskingum fine sandy loam
Muskingum fine sandy loam, eroded phase
Muskingum fine sandy loam, very gently sloping phase
Muskingum silt loam
Muskingum silt loam, colluvial phase
Muskingum silt loam, eroded phase
Muskingum silt loam, very gently sloping colluvial phase
Rarden silt loam
Rarden silt loam, eroded phase
Rarden silt loam, very gently sloping phase
Tilsit silt loam
Tuscarawas silt loam
Tuscarawas silt loam, eroded phase
Wellston silt loam

Wellston silt loam, eroded shallow phase
Wellston silt loam, shallow phase
Wellston silt loam, sloping phase

Other soils of group 1, because of steep slopes, severe erosion, stoniness, or poor drainage, are considered better suited to permanent pasture or forest. Nevertheless, some of these soils are used for crops, particularly where there are no better soils on the farm. The difficulty of preparing and maintaining these soils is greater and yields are lower than for the soils considered suitable for rotation crops. Soils of group 1 considered better suited to pasture or forest are:

Gullied land (Eifort and Rarden soil materials)
Gullied land (Muskingum soil material)
Keene-Rarden-Eifort silty clay loams, eroded steep phases
Keene silt loam, severely eroded phase
Keene silt loam, severely eroded steep phase
Made land, mine pits, and dumps [8]
Muskingum fine sandy loam, eroded steep phase
Muskingum fine sandy loam, eroded very steep phase
Muskingum fine sandy loam, steep phase
Muskingum fine sandy loam, very steep phase
Muskingum silt loam, eroded steep phase
Muskingum silt loam, eroded very steep phase
Muskingum silt loam, severely eroded phase
Muskingum silt loam, severely eroded steep phase
Muskingum silt loam, severely eroded very steep phase
Muskingum silt loam, steep phase
Muskingum silt loam, very steep phase
Muskingum stony fine sandy loam
Muskingum stony fine sandy loam, eroded steep phase
Muskingum stony silt loam
Muskingum stony silt loam, eroded phase
Muskingum stony silt loam, eroded very steep phase
Muskingum stony silt loam, very gently sloping phase
Muskingum stony silt loam, very steep phase
Seepy land (Muskingum and Keene soil materials)

For the important soils of group 1 the pH value, suggested lime treatment to give a reaction favorable for alfalfa mixtures and bluegrass pasture, and special erosion control measures are listed in table 7.

[8] Largely wasteland, but some areas may be suitable for forest. This land type is not confined entirely to the soil areas of this upland group.

TABLE 7.—*pH value, lime applications, and special erosion control practices for alfalfa mixtures and bluegrass pasture on some of the important soils of group 1*

Soil	pH	Initial applications of agricultural ground limestone per acre on unlimed soils for—		Special erosion control practices
		Alfalfa mixtures in a rotation	Bluegrass pasture	
		Tons	*Tons*	
Eifort silty clay loam	5. 1–5. 5	3. 5–4	2	Strip cropping, diversion terraces, sod waterways, 50 percent or more of land in sod crops.
Keene silt loam	5. 1–5. 5	3. 5–4	2	Do.
Muskingum fine sandy loam	5. 0–5. 5	3. 5–4	2	Do.
Muskingum silt loam	5. 0–5. 5	3. 5–4	2	Do.
Tuscarawas silt loam	5. 0–5. 5	3. 5–4	2	Do.
Tilsit silt loam	5. 0–5. 5	3. 5–4	2	No special practices needed.
Wellston silt loam	5. 0–5. 5	3. 5–4	2	Do.

GROUP 2. SOILS OF UPLANDS DEVELOPED ON GLACIAL TILL DERIVED FROM SANDSTONE, SILTSTONE, AND SHALE MATERIALS

Although these soils derived from glacial till are similar in management requirements to the residual upland soils, they occupy a gently rolling topography and do not have so serious an erosion hazard. The soils of this group are the Canfield, Wooster, and Hornell. The Wooster soils are well drained, whereas the Canfield and Hornell soils have imperfect underdrainage. Where shale occurs at shallow depths and tile drainage is impossible, the Hornell soil can best be used for meadow or pasture. With this exception, all the soils of group 2 can be used as rotation cropland.

Soils of group 2 are:

Canfield silt loam
Hornell silt loam
Wooster silt loam
Wooster silt loam, gently undulating phase

The important soils of this group, together with their pH value, suggested lime treatment to give a reaction favorable for alfalfa mixtures and bluegrass pasture, and special erosion control practices, are given in table 8.

TABLE 8.—*pH value, lime applications, and special erosion control practices for alfalfa mixtures and bluegrass pasture on some of the important soils of group 2*

Soil	pH	Initial applications of agricultural ground limestone per acre on unlimed soils for—		Special erosion control practices
		Alfalfa mixtures in rotation	Bluegrass pasture	
		Tons	*Tons*	
Canfield silt loam	5. 0–5. 5	3. 5–4	2	Contour cropping, strip cropping, sod waterways.
Wooster silt loam	5. 0–5. 5	3. 5–4	2	Do.
Hornell silt loam	5. 0–5. 5	3. 5–4	2	No special practices needed.

CROPPING SYSTEMS FOR SOILS OF GROUPS 1 AND 2

The cropping system on a farm is satisfactory if (1) high acre yields are obtained over a period of years and (2) the productivity of the land is raised to and maintained at a high level. The cropping program must be economically sound but will vary according to the kind and number of livestock on the farm.

The following suggestions for soil use and management apply to all soils of groups 1 and 2 but in different degree. Soils with very slowly permeable subsoil, like the Keene, present more of an erosion hazard than do those with porous subsoil, like the Muskingum. Hence, longer rotations with a greater proportion of sod crops are desirable on the more erodible soils. Many farmers in the western part of the county are keeping the land in meadow or pasture much of the time and have farmed for many years without serious erosion. In this western area, dairy farming has developed extensively.

Soil-improvement crops.—From the standpoint of the maintenance of soil productivity, the soil-improvement crop is the most important one in the rotation. On most farms this crop furnishes all the hay needed and considerable grazing. Hayfields should be used for summer grazing to a greater extent than they have been in the past. The hayfields that are to be plowed the following spring will furnish grazing in summer and fall when dry weather reduces the growth of the bluegrass pastures.

Farmers who have high hay yields have high yields of other crops; those who have low hay yields have low yields of other crops. Growing good crops of hay and pasture and plowing under good sods are the first steps in increasing soil productivity. Plowing under good sods in a satisfactory rotation maintains the organic-matter content of the soil. The liberal use of fertilizer is not a satisfactory substitute for good sods, since the plowing under of good sods is necessary to provide

good soil tilth. In many heavy soil areas of Ohio crop yields are low because of poor tilth, which means that the soil is difficult to work, that the soil air supply is limited, and that surplus water cannot drain away readily.

Whatever is necessary to grow good sod crops should be done. It is not necessary that all the hayfield be harvested for hay. When not needed for hay or grazing, the growth may be left on the field to be plowed under the following spring. Many farms do not have enough land in hay to supply all the hay needed and an abundance of summer and fall pasture. On these farms some of bluegrass pasture may be seeded to hay mixtures for grazing or added to the crop-rotation land.

Liming materials.—The use of liming materials, as needed, is the first step in improving soil productivity. This is necessary before alfalfa, alone or in mixtures, or sweetclover can be grown. The application needed will vary, depending on the soil and on previous applications. Use of fertilizers and other soil-building practices cannot be entirely effective until soil acidity has been corrected.

The agricultural leaders of a community can promote programs for delivering and spreading lime as needed. Spreading lime in summer and in late fall on meadows to be plowed for corn the following spring is essential; the work peaks occurring in spring and in September now limit use of liming materials. Bluegrass pastures may be limed when liming materials cannot be spread on other fields.

The application recommended should be made as early as possible. When it cannot be made until the second or third rotation, it must be assumed that there has been a loss of 1 ton of lime and acre every 5 years. An application of 1 ton of agricultural ground limestone every 4 or 5 years is recommended when the field has been limed so that alfalfa mixtures do well. On good bluegrass pastures an application of 1 ton of agricultural ground limestone every 6 or 8 years is recommended. Equivalent quantities of various kinds of agricultural liming materials are given in table 9.

TABLE 9.—*Equivalent applications of different liming materials for a 4-year treatment*[1]

Liming material	Application through 100-mesh screen	Quantity equal to 1 ton of agricultural ground limestone
	Percent	*Pounds*
Agricultural limestone meal:		
Coarse	20–29	2, 900
Fine	30–39	2, 400
Agricultural limestone:		
Ground	40–59	2, 000
Pulverized	60–79	1, 700
Superfine	80–100	1, 600
Hydrated lime:		
TNP=135[2]	100	1, 200
TNP=165	100	1, 000

[1] From Ohio Agr. Col. Ext. Bul. 268.
[2] TNP equals total neutralizing power; the TNP of limestone is about 100.

Fertilizers, manure, and crop residues.—For the livestock or general farm the most important fertilizer application is the one made for the grain crop with which new seedings of forage crops are made. The application for the crop should be increased to 300 or 400 ponds an acre of 0–12–12 or 3–12–12 as soon as possible and before increasing the applications on the other crops of the rotation.

The row or hill fertilizer application for corn is also essential. Corn planted in check should have 150 pounds an acre of 0–12–12 or 3–12–12 in the hill; and drilled corn, up to 300 pounds in the row. Established hayfields for hay or grazing should have 250 pounds of 0–12–12 or 3–12–12 the second or third hay year and every second year thereafter. Although alfalfa is the ideal crop for feeding livestock, for soil improvement, and for adding nitrogen to the soil, it is a heavy feeder on lime, potash, and phosphorus. An average alfalfa crop removes 30 to 90 percent more plant nutrients than red clover. If alfalfa is to be grown successfully, these elements must be supplied abundantly in lime and fertilizer. Ohio farmers are now using more potash than in the past, and even more potash is recommended. Fertilizer applications for alfalfa can generally be profitably increased 50 to 100 percent.

Current recommendations on fertilizer use can be obtained from the Agricultural Extension Service, Ohio State University, Columbus 10, Ohio. Table 10 gives fertilizer applications, as recommended in 1945, for a 4-year rotation common to the region.

TABLE 10.—*Fertilizer recommendations for a 4-year rotation*

Year	Crop	Application per acre	
		Manure	Fertilizer
First	Corn	6 to 10 tons on sod before plowing for corn.	150 pounds of 0–12–12 or 3–12–12 in hill, or 300 in row.
Second	Winter wheat	4 to 8 tons on wheat in fall or winter.	300 pounds of 0–12–12 or 3–12–12.
Third	Hay mixture (alfalfa, clover, timothy).[1]		
Fourth	Hay or pasture		

[1] Seeding rate: Alfalfa, 6 pounds; clover, 4 pounds; timothy, 3 pounds. For other seeding mixtures, see Ohio Agr. Col. Ext. Bul. 261, 1945.

Manuring wheat for the benefit of the new hay or pasture seeding is an essential practice on light-colored soils of average productivity or less. Wheat has a priority on manure produced on the farm, and manuring is possibly the most important practice in obtaining better hay crops on thousands of Ohio farms. On highly productive light-colored soils on the State Experiment Farm at Wooster, manuring of wheat has increased yields by 800 pounds an acre.

The steeper and less productive areas in wheat should be manured first in fall, and the applications continued until clover and alfalfa seed are sown. Four to eight loads an acre are sufficient where the

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manure can be evenly spread. It should not be used where the wheat is likely to lodge. Manuring wheat usually produces better sods to plow under, so that the next corn crop is benefited. If sufficient manure is available, the thinner spots in the next year's hayfields can be fertilized. The manure should be handled so that loss of nutrients before it reaches the field is reduced to a minimum.

Straw and cornstalks not needed for bedding or feed should be left on the field. Handling manure to avoid unnecessary loss of nutrients and leaving crop residues on the field are means by which smaller quantities of nutrients are removed from the field. These two practices are therefore important in maintaining soil productivity.

Fall growth of hay crops.—Some of the hayfields in Ohio are poor because of mismanagement of the stand after it starts growth. Clover and alfalfa plants store food in their roots, carry them over winter, and use them to start growth the following spring. This storage takes place late in September and in October, and a good top growth is necessary for the manufacture of the food. New seedings of alfalfa should not be mowed or pastured close after September 1, and in the following year the alfalfa should grow undisturbed after September 10. Late pasturing or mowing results in winterkilling and poor hayfields every year. The hayfield that is to be plowed the following spring may be used for fall pasture. Close grazing is less detrimental on this field than on bluegrass pastures or hayfields to be kept for cropping another year.

Rotations.—A proper balance between soil-depleting and soil-conserving crops is essential. A good rotation will not do what is desired unless good stands of sod crops are obtained, good sods are plowed under, and necessary erosion control practices are followed. Clover mixtures must necessarily be used where the soil is not ready for alfalfa. Alfalfa does not need to be included in all seeding mixtures, since many farmers plan to harvest clover seed.

Best for the livestock farm is a 4-year rotation of corn, small grain, and alfalfa mixtures. This rotation is desirable for sloping land, but on the steeper areas there should be a larger proportion of sod crops. The second-year hay may be used for summer pasture, as may the second and third growth of hay the first year. A 4-year rotation of corn, oats, wheat, and hay contains too many small-grain crops.

A 3-year rotation of corn, small grain, and hay is widely used. In this rotation alfalfa mixtures are preferable to clover mixtures, but even so, a good farmer is needed to maintain productivity with this rotation, even on level land. Such a rotation is not suited to slopes and is more likely to be successful on a livestock farm than on a grain farm.

Erosion control.—An adequate plan for saving soil and water should be in operation on all sloping lands. The land should be in hay crops half or more of the time, although some of the hay crops may be grazed. Good sods should be plowed under. Only the more gentle slopes should be used for cultivated crops, and productivity should be maintained at a high level. The rotation should have a high proportion of sod to other crops; for example, corn, small grain, and meadow for 2 years or more.

All corn and grain crops should be planted in contour strips or on the contour. Diversion terraces to lead away part of the runoff water

are essential on long slopes, and sod waterways should be left in drainage channels. Field strips that cross the general slope may be necessary on irregular slopes. In starting a new hayfield, seed the hay mixture in strips in the small-grain crop. The land may be used for bluegrass pasture or for alfalfa mixtures for hay or pasture. Very steep slopes and badly eroded areas should be forested.

Pasture improvement.—Lime is essential to bluegrass pasture. The quantity needed is determined by testing the soil. The lime can be applied at any convenient time, usually in summer or fall. On steep land or where the vegetation is thin, grooving on the contour with a disk harrow will allow better incorporation of lime. A ton of lime an acre applied every 6 to 8 years will maintain a satisfactory soil reaction.

Where disking can be done, apply 400 pounds an acre of 0–14–7 to the pasture after disking. The most satisfactory time of application is between October 1 and April 1. This application should be repeated every 4 or 5 years.

Manure is not extensively used on permanent pastures, but on thin sods it may be an effective means of pasture improvement. The usual rate of application is 6 or 8 tons an acre. This treatment may be repeated every 3 or 4 years.

Seeding is recommended where rapid pasture improvement is desired or where weeds predominate. Bluegrass pastures should be in condition to permit mowing and the use of lime and fertilizer spreaders. Rough pastures should be plowed or disked so they can be leveled and then seeded. Where a field is kept as a bluegrass pasture and is to be pastured during the season, an early spring seeding of ½ to 1 pound an acre of Ladino clover, made after the necessary liming materials and fertilizer have been applied, is recommended.

Within a pasture that has been treated with lime and fertilizer and reseeded it may be desirable to cover any badly eroded areas with brush to protect them from grazing until the sod has become established. In gullied areas it may be necessary to build sod, brush, or low stone dams that will provide some temporary control of water until the sod can be established. The gully banks should be graded back, limed as needed, liberally fertilized, and seeded with a mixture that includes orchard grass. Temporary exclusion of livestock by using brush or by fencing is necessary for development of a good sod on a gullied bank.

Regardless of how well permanent pastures are limed and fertilized, satisfactory sods cannot be developed or maintained unless careful management is practiced. The land should be grazed to keep the vegetation between 1½ to 5 inches high at all times, but not continuously as short as 1½ inches. If the vegetation can be kept within these heights, a white clover-bluegrass sod will develop rapidly. Particular care should be taken not to overgraze in early spring or in July or August. Clipping before September 1 to control weeds is desirable.

To provide adequate summer grazing some of the meadows can be used for pasture as well as for hay. If the meadow is to be pastured all or part of the time, ½ to 1 pound to the acre of Ladino clover seed should be added to the meadow-seeding mixture. On farms where all rotation meadows can be grazed, meadows to be plowed the following

spring should be pastured throughout the season. After the first cutting of hay, meadows to be kept for hay the following year may be grazed in summer up to September 10. On farms where strip cropping is practiced, it may be desirable to prevent overgrazing by dividing the meadow into two fields with an electric fence. In case some rotation meadows cannot be grazed because of lack of water, or fencing, or for some other reason, two or three fields least adapted to corn and grain crops because of slope or poor drainage can be removed from the rotation, seeded to legume-grass mixtures, and used for summer grazing. They should be reseeded when necessary. The first growth may occasionally be harvested for hay.

The development of semipermanent meadows and rotation pastures by seeding without plowing, often called the trash-mulch method, is well adapted to areas of rundown pastures. This method is also adapted to reestablishing permanent pastures. The steps are as follows:

1. Lime the soil to prepare it for alfalfa mixtures, after first testing it to determine the quantity of lime required.
2. Disk thoroughly. Few farmers disk enough the first time this method of seeding is used. Disk as much as appears to be needed the first week and once or twice the following week so that the vegetation present is almost completely killed. It is usually preferable to apply the liming materials during summer or early fall and to do most of the disking before winter. This will permit the essential early spring seeding. Where there is a serious erosion hazard, the soil can be disked late in March or in April.
3. Fertilizer with 0–14–7 or 0–12–12 at a rate of 400 to 500 pounds to the acre, applying the fertilizer with a grain drill at the time of seeding.
4. Seed alfalfa, clover, and grass shallow; broadcast it or drop it back of drill disks or hoes. Include Ladino clover if the field is to be grazed all or part of the time. Cover seed with a cultipacker if convenient.
5. Mow the area close if weeds threaten to destroy the seeding. With a good growth the seeding may be harvested for hay or pastured once before September 1. Permit the seeding to grow undisturbed after September 1. Generally the entire growth should be left on the field during the first year.

Forested areas.—Very steep areas, rough broken areas, or seriously eroded areas should be planted to trees. This will serve as a protection against further serious erosion and will eventually produce a valuable crop of timber. For species best adapted, the advice of the State forester or extension forester should be obtained. For the successful development of forest, livestock should be kept out at all times.

Group 3. Soils of Uplands Developed From Limestone, Sandstone, Siltstone, and Shale Materials

Soils of group 3 occupy rolling to steep topography and have developed from limestone, sandstone, siltstone, and shale materials. They are used chiefly for general farming, with some livestock. Much of their acreage is in permanent pasture; the ridge tops and upper slopes are used for cultivated crops. Excellent bluegrass sods grow on these limestone soils and make them less erodible than the Muskingum soils on comparable slopes.

Of the soils in group 3, the following are considered suitable for rotation crops, although a relatively large proportion is in permanent pasture:

Muskingum-Brooke complex (formerly Westmoreland silty clay loam)

Muskingum-Brooke complex, eroded phases (formerly Westmoreland silty clay loam, eroded phase)
Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam)
Muskingum-Upshur-Brooke complex, eroded phrases (formerly Belmont silty clay loam, eroded phase)
Upshur-Muskingum complex (formerly Meigs silty clay loam)
Upshur-Muskingum complex, eroded phases (formerly Meigs silty clay loam, eroded phase)

The soils of group 3 considered better suited to permanent pasture are listed below. Where proper measures for control of erosion are followed, however, it is possible to cultivate slopes as great as 25 percent.

Muskingum-Brooke complex, eroded steep phases (formerly Westmoreland silty clay loam, eroded steep phase)
Muskingum-Upshur-Brooke complex, eroded steep phases (formerly Belmont silty clay loam, eroded steep phase)

CROPPING SYSTEM FOR SOILS OF GROUP 3

The chief crops for soils of group 3 are corn, small grains, and hay. Alfalfa can be grown without liming on many of these soils, but it is desirable to test various parts of fields to determine the areas that require liming, for the acid Muskingum soils are included in the complexes.

The important soils of this group, together with their pH value, suggested lime treatment to give a reaction favorable for alfalfa mixtures and bluegrass pasture, and special erosion control practices, are given in table 11.

TABLE 11.—*pH value, lime applications, and special erosion control practices for alfalfa mixtures and bluegrass pasture on some of the important soils of group 3*

Soil	pH	Initial applications of agricultural ground limestone per acre on unlimed soils for—		Special erosion control practices
		Alfalfa mixtures in rotation	Bluegrass pasture	
		Tons	*Tons*	
Muskingum-Brooke complex (formerly Westmoreland silty clay loam).	5. 0–6. 5	0–3. 5	0–2	Contour cropping, strip cropping, diversion terraces, sod waterways.
Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam).	5. 0–6. 5	0–3. 5	0–2	Do.
Upshur-Muskingum complex (formerly Meigs silty clay loam).	5. 0–6. 0	1–4. 0	1–2	Do.

Fertilizer recommendations for a 6-year rotation on the soils of group 3 are given in table 12.

TABLE 12.—*Fertilizer recommendations for a 6-year rotation on the soils of group 3*

Year	Crop	Application per acre	
		Manure	Fertilizer
First	Corn	6 to 10 tons on sod previous year.	150 pounds of 0–12–12 or 3–12–12 in the hill, or 300 in row.
Second	Wheat or other grain.	4 to 8 tons as top dressing on winter grains.	400 pounds of 0–12–12 or 3–12–12.
Third	Hay mixture (alfalfa, clover, timothy).[1]		
Fourth	Hay or pasture	6 tons; none if 250 lb. of 0–12–12 is used.	200 pounds of superphosphate, or 250 of 0–12–12.
Fifth	do		
Sixth	do	Application on sod; see first year.	

[1] Seeding rate: Alfalfa, 6 pounds; clover, 4 pounds; timothy, 3 pounds. For other seeding mixtures see Ohio Agr. Col. Bul. 261, 1945.

Since group 3 soils are well adapted to grass and legumes, long rotations that supply midsummer pasture and winter feed of high protein content are particularly desirable. The meadows can be cut for hay in June and grazed during July and August. The land should be protected from grazing after September 1, unless the field is to be plowed the following spring. If the pasture is grazed in rotation, a height of 8 to 12 inches should be allowed between grazings. Where the pasture is continuously grazed, a height of 6 to 10 inches must be maintained at all times.

Suggestions already made for the residual sandstone and shale soils as to use of fertilizer, liming, the importance of sod crops, erosion control, and pasture improvement apply equally well to these soils.

On lands too steep for cultivated crops, corn may be omitted from the rotation. Very steep slopes or those with serious erosion should be permitted to revert to forest. Planting of forest trees is desirable on some areas.

USE AND MANAGEMENT OF SOILS OF TERRACES

Soils of the terraces occur on nearly level relief along the streams and are especially favorable for cultivated crops. Only the terrace escarpment or borders have a sloping topography, and these are usually narrow areas of small extent. Many farms include both terrace and first-bottom lands. Along the sides of the larger valleys and in some of the minor valleys, sloping uplands are commonly included in the farms. These uplands can well be used chiefly for pasture of either bluegrass or alfalfa mixtures, and Ladino clover is especially desirable.

According to subsoil permeability, group 4 soils may be divided into two subgroups. First are the Chenango and Conotton soils with gravel and sand in the subsoil. They are freely permeable, have good natural drainage, and occur along the Tuscarawas River, Sugar Creek, and other streams that drain from the glaciated area. Second are the Holston, Monongahela, Tyler, and Zaleski soils with silt and clay subsoil. These are moderately to slowly permeable and in many areas have imperfect to poor drainage for which tile drains would be desirable. The spacing of the tile lines should vary with subsoil conditions; 4 rods is considered adequate except where heavy clay is near the surface. If the clay is near the surface a spacing of 2 or 3 rods is desirable.

Group 4. Soils Developed From Alluvial Material on Terraces

The soils of the terraces are divided into the three following subgroups on the basis of drainage and use.

Soils naturally well drained and used as rotation cropland:

Chenango fine sandy loam
Chenango fine sandy loam, eroded gently sloping phase
Chenango fine sandy loam, gently sloping phase
Chenango gravelly loam
Chenango gravelly loam, gently sloping phase
Chenango loam
Chenango loam, eroded gently sloping phase
Chenango loam, gently sloping phase
Chenango loamy fine sand
Chenango loamy fine sand, eroded gently sloping phase
Chenango silt loam
Chenango silt loam, deep phase
Chenango silt loam, eroded gently sloping phase
Chenango silt loam, gently sloping phase
Chenango silt loam, silted phase
Conotton fine sandy loam
Conotton gravelly silt loam
Conotton loam
Conotton loam, eroded gently sloping phase
Conotton silt loam
Conotton silt loam, silted phase
Holston fine sandy loam

Soils with silt and clay substratum that in many areas have slightly retarded to poor underdrainage and are used as rotation cropland:

Monongahela silt loam
Monongahela silt loam, eroded light-textured subsoil phase
Monongahela silt loam, eroded phase
Monongahela silt loam, eroded undulating phase
Monongahela silt loam, light-textured subsoil phase
Monongahela silt loam, undulating phase
Tyler silt loam
Tyler silty clay loam
Zaleski silt loam

Some steep and eroded soils of group 4 may be used for cultivated crops, but the difficulty of preparing and maintaining them is greater and yields are lower than for other soils in the group. These soils are therefore best suited to permanent pasture or forest and are listed as follows:

Chenango gravelly loam, eroded steep phase
Holston silt loam, eroded steep phase

CROPPING SYSTEMS FOR SOILS OF GROUP 4

Corn, small grain, hay, and truck crops are grown on the soils of group 4. More corn is grown than on the upland soils. Chenango silt loam is desirable for potatoes. Truck crops are grown on the well-drained soils of the terraces, especially the loams and fine sandy loams.

The meadow mixture used depends on the reaction and the drainage of the soils. Alfalfa-grass mixtures are desirable when the soil is well supplied with lime. Liming is essential on most of the terrace soils. For potatoes, however, the reaction should not be above pH 5.3, because of the possibility of scab. A green-manure crop, as rye or winter wheat, can be grown and plowed under for potatoes. Fertilizer is desirable for most crops. Management suitable for light-colored upland soils is also appropriate for crops on soils of this group.

The important soils of group 4, together with their pH value, suggested lime applications for alfalfa mixtures, and special erosion control practices, are given in table 13. Crop rotations for group 4 soils are suggested in table 14.

TABLE 13.—*pH value, lime applications for alfalfa mixtures, and special erosion control practices on some of the important soils of group 4*

Soil	pH	Initial applications of agricultural ground limestone per acre on unlimed soils for alfalfa mixtures in rotation	Special erosion control practices
		Tons	
Soils with gravel and sand substratum:			
Chenango silt loam	5.0–5.5	3.5–4.0	No special practices needed.
Conotton silt loam	5.5–6.0	2.0–3.0	Do.
Soils with silt and clay substratum:			
Holston fine sandy loam	5.0–5.5	3.0–3.5	Do.
Monongahela silt loam	5.0–5.5	3.5–4.0	Do.
Tyler silt loam	4.5–5.5	3.5–4.5	Do.
Tyler silty clay loam	5.0–5.5	3.5–4.5	Do.
Zaleski silt loam	5.0–5.5	3.5–4.0	Do.

TABLE 14.—*Crop rotations for soils of group 4*

Year	3-year rotation	4-year rotation	4-year rotation
First	Corn	Corn	Corn.
Second	Wheat or other small grain.	Wheat or other small grain.	Oats.
Third	Meadow	Meadow	Wheat.
Fourth		Meadow (hay or pasture).	Meadow.

USE AND MANAGEMENT OF SOILS OF FLOOD PLAINS

The alluvial soils on flood plains are some of the most productive in the county. Because of the hazard of flooding, however, they are best adapted to corn and hay or pasture. Very poorly drained areas are suited only to pasture. Some truck crops are grown on the well-drained soils, especially on the high-bottom areas. Small grains tend to lodge badly.

Group 5. Soils Developed From Recent Alluvial Material on Stream Flood Plains

Group 5 contains a large number of different soils. Those more prominent are the Chagrin, Lobdell, and Wayland soils occurring chiefly along streams that drain from the glaciated area north of the county. These soils are frequently associated with terrace soils, such as the Chenango and Conotton. Pope, Philo, and Atkins soils, also important in the group, occur along streams in all parts of the county. The soils of group 5 are divided into three subgroups, as follows:

- Well-drained soils:
  - Chagrin fine sandy loam
  - Chagrin loam
  - Chagrin loam, high-bottom phase
  - Chagrin silt loam
  - Chagrin silt loam, high-bottom phase
  - Lobdell silt loam
  - Lobdell silt loam, high-bottom phase
  - Philo loam
  - Philo silt loam
  - Philo silt loam, high-bottom phase
  - Pope fine sandy loam
  - Pope loam
  - Pope loam, high-bottom phase
  - Pope silt loam
  - Pope silt loam, high-bottom phase
- Poorly drained soils:
  - Atkins fine sandy loam
  - Atkins silt loam
  - Atkins silt loam, high-bottom phase
  - Atkins silty clay loam
  - Elkins silty clay
  - Killbuck silt loam
  - Wayland silt loam
- Miscellaneous land type unsuited to agriculture:
  - Riverwash

CROPPING SYSTEMS FOR SOILS OF GROUP 5

A rotation commonly used for the flood plain soils consists of corn 2 years in succession, followed by alfalfa or alfalfa mixtures for 2 or 3 years. New alfalfa seedings are established with oats as a nurse crop, or seedings may be made without a companion crop.

The soils range from neutral to strongly acid. Liming is essential in most areas, though some fields will produce excellent stands of alfalfa without liming. The lime requirements for alfalfa mixtures on the important soils of group 5, together with pH value, are given in table 15.

TABLE 15.—*pH value and lime requirements for alfalfa mixtures on the important soils of group 5*

Soil	pH	Initial applications of agricultural ground limestone per acre on unlimed soils for alfalfa mixtures in rotation
		Tons
Atkins silt loam	4. 5–5. 0	3. 5–4. 5
Chagrin silt loam	6. 0–6. 5	0–1. 0
Elkins silty clay	5. 0–5. 5	3. 0–4. 0
Killbuck silt loam	5. 0–5. 5	3. 5–4. 0
Lobdell silt loam	6. 0–6. 5	0–1. 0
Philo silt loam	5. 0–5. 5	3. 5–4. 0
Pope silt loam	5. 0–5. 5	3. 5–4. 0
Wayland silt loam	5. 0–5. 5	3. 5–4. 0

Use of fertilizer is essential, especially on the larger bottoms where corn is grown extensively. Current recommendations of the Ohio Agricultural Extension Service should be obtained. Fertilizers are not used on some of the flood-plain areas because the alluvium deposited by flood waters is depended on to fertilize the land. A somewhat smaller application of fertilizer than recommended for the soils of the uplands and terraces will be adequate on soils of the lower, or first-bottom, lands.

On farms that include both bottom land and hill land, most of the cultivated crops should be produced on the flood-plain soils. In this way it is possible to decrease the area of sloping land used for cultivated crops and to better control erosion. The high-bottom phases of the various soils are not so frequently overflowed as the typical soil units. These higher phases are intermediate in character between the flood-plain soils and the terrace soils and have management requirements approaching those of the terrace soils.

ESTIMATED CROP YIELDS FOR TUSCARAWAS COUNTY SOILS

Estimated average acre yields to be expected over a period of years from each soil of the county under both common and better farming practices are given in table 16.

The estimates in columns A are to be expected, on the average, with practices that include the use of small to moderate quantities of commercial fertilizer but that generally do not include intensive soil management in control of erosion, incorporation of organic matter, and maintenance and increase of soil fertility and soil productivity. In columns B the average acre yields are predicted under practices that include use of a regular crop rotation; growing legumes where possible; application of barnyard and green manures, lime, and liberal quantities of suitable commercial fertilizers; artificial drainage where necessary; seeding improved high quality seed from improved varieties, and, where needed, contour tillage, strip cropping, and terracing or digging of diversion ditches for control of erosion.

TABLE 16.—*Tuscarawas County, Ohio, soils: Estimated average acre yields* [...] *period of years*

[In columns A—without use of manure, amendments, or beneficial crop rotation. In columns B—u[...] including rotations, erosion control practices, and use of legumes, commercial fertilizers, lim[...] Absence of a yield figure indicates the crop is not commonly grown or that data on pasture yi[...]

Soil	Corn		Wheat		Oats		Mixed clover and timothy hay		Alfalfa mixture	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Ton*[...]
Atkins fine sandy loam [2]	15	30			15	30	0.5	1.2		1.5
Atkins silt loam [2]	15	36			18	30	.5	1.3		2.0
High-bottom phase [2]	15	36			18	32	.5	1.3		2.0
Atkins silty clay loam [2]	15	40			15	30	.5	1.4		2.0
Canfield silt loam	32	54	22	30	38	45	1.0	1.7	2.5	3.0
Chagrin fine sandy loam	18	36	12	22	20	30	.7	1.7	1.7	3.0
Chagrin loam	40	65	18	24	30	40	1.6	2.5	2.2	3.0
High-bottom phase	40	60	20	26	30	40	1.6	2.5	2.3	3.0
Chagrin silt loam	40	65	22	26	30	45	1.8	2.5	2.6	3.5
High-bottom phase	40	60	24	28	35	45	1.8	2.5	2.6	3.5
Chenango fine sandy loam	25	36	13	25	18	25	1.0	1.6	1.5	3.0
Gently sloping phase	15	25	9	23	13	20	1.0	1.6	1.2	2.6
Eroded gently sloping phase	12	20	7	15			.6	1.0	.8	1.8
Chenango gravelly loam	25	42	15	26	20	28	1.2	1.6	1.7	3.0
Gently sloping phase	15	30	10	24	14	23	1.0	1.6	1.5	2.6
Eroded steep phase										
Chenango loam	30	48	17	28	25	30	1.2	1.8	1.7	3.0
Gently sloping phase	18	36	12	26	18	25	1.0	1.8	1.5	2.8
Eroded gently sloping phase	14	25	8	24	12	20	.6	1.4	.9	2.0

See footnotes at end of table.

Table 16.—*Tuscarawas County, Ohio, soils: Estimated average acre yields that m* *years*—Continued

Soil	Corn		Wheat		Oats		Mixed clover and timothy hay		Alfalfa mixture	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Ton*
Chenango loamy fine sand	20	36	13	20	15	22	0.8	1.4	----	----
Eroded gently sloping phase	----	----	----	----	----	----	----	----	----	----
Chenango silt loam	35	60	25	35	28	35	1.5	2.2	2.2	3.5
Deep phase	38	65	28	38	30	40	1.8	2.5	2.5	3.8
Silted phase	36	62	26	36	28	38	1.5	2.0	2.0	3.5
Gently sloping phase	20	35	15	33	20	25	1.5	2.0	2.4	3.0
Eroded gently sloping phase	15	30	11	28	14	20	.9	1.6	1.8	2.5
Conotton fine sandy loam	25	40	15	25	20	30	1.0	1.6	1.5	3.0
Conotton gravelly silt loam	25	45	15	25	20	30	1.2	1.6	1.7	3.0
Conotton loam	30	50	18	26	20	30	1.2	1.9	1.7	3.0
Eroded gently sloping phase	15	25	8	21	12	20	.6	1.5	.9	2.0
Conotton silt loam	35	60	20	30	25	35	1.5	2.4	2.0	3.5
Silted phase	36	62	21	31	27	37	1.5	2.0	2.0	3.0
Eifort silty clay loam [2]	25	42	10	20	20	35	1.0	1.5	1.5	3.0
Eroded phase [2]	----	----	----	----	----	----	----	----	----	----
Elkins silty clay [2]	25	50	----	----	15	25	.6	1.4	----	2.5
Gullied land:										
Eifort and Rarden soil materials	----	----	----	----	----	----	----	----	----	----
Muskingum soil material	----	----	----	----	----	----	----	----	----	----
Holston fine sandy loam	22	45	12	25	20	30	1.0	1.6	1.2	2.5
Holston silt loam, eroded steep phase	----	----	----	----	----	----	----	----	----	----
Hornell silt loam [2]	20	42	14	24	30	36	.8	1.5	2.2	3.0
Keene silt loam	25	42	15	25	25	38	1.1	2.0	1.5	3.0
Eroded phase	15	33	12	20	20	28	.6	1.6	----	2.0

Severely eroded phase										
Very gently sloping phase	25	45	15	28	25	40	1.1	2.0	1.5	3.0
Eroded very gently sloping phase	20	35	12	23	22	30	.6	1.6		2.0
Eroded steep phase										
Severely eroded steep phase										
Keene-Rarden-Eifort silty clay loams, eroded steep phases										
Killbuck silt loam [2]	35	63	18	24	25	35	1.5	2.0		2.5
Lobdell silt loam	30	54	15	22	30	35	1.4	2.0	1.8	2.7
High-bottom phase	34	54	16	24	32	36	1.4	2.5	1.8	2.7
Made land, mine pits, and dumps										
Monongahela silt loam	24	54	13	26	20	35	1.1	2.0	1.5	3.0
Eroded phase	14	46	11	21	14	25	.7	1.6		2.5
Undulating phase	22	50	12	24	20	30	1.0	1.8	1.2	2.6
Eroded undulating phase	12	40	8	21	12	20	.6	1.4		2.0
Light-textured subsoil phase	27	58	15	27	22	35	1.0	1.8	1.2	2.8
Eroded light-textured subsoil phase	16	48	10	22	16	25	.7	1.6		2.6
Muskingum fine sandy loam	25	42	12	23	25	40	.8	1.7	1.5	3.0
Eroded phase	14	32	9	18	20	35	.6	1.4		2.5
Very gently sloping phase	28	45	12	25	25	40	.8	1.8	1.8	3.0
Steep phase										
Eroded steep phase										
Very steep phase										
Eroded very steep phase										
Muskingum silt loam	28	55	14	25	25	40	1.0	1.8	2.0	3.0
Eroded phase	16	45	12	20	20	30	.6	1.4		2.5
Severely eroded phase										
Colluvial phase	32	56	15	28	25	40	1.0	1.8	1.5	3.0
Very gently sloping colluvial phase	35	58	16	30	25	40	1.0	1.8	1.8	3.0
Steep phase										
Eroded steep phase										
Severely eroded steep phase										
Very steep phase										
Eroded very steep phase										
Severely eroded very steep phase										
Muskingum stony fine sandy loam										
Eroded steep phase										

See footnotes at end of table.

TABLE 16.—*Tuscarawas County, Ohio, soils: Estimated average acre yields that m*
years—Continued

Soil	Corn		Wheat		Oats		Mixed clover and timothy hay		Alfalfa mixture	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Ton*
Muskingum stony silt loam										
Eroded phase										
Very gently sloping phase										
Very steep phase										
Eroded very steep phase										
Muskingum-Brooke complex (formerly Westmoreland silty clay loam)	34	58	19	31	38	47	1. 4	2. 7	2. 2	3. 7
Muskingum-Brooke complex, eroded phases (formerly Westmoreland silty clay loam, eroded phase)	19	48	14	26	30	40	1. 0	2. 4	1. 4	3. 3
Muskingum-Brooke complex, eroded steep phases (formerly Westmoreland silty clay loam, eroded steep phase)										
Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam)	33	54	18	30	40	50	1. 4	2. 6	2. 2	3. 7
Muskingum-Upshur-Brooke complex eroded phases (formerly Belmont silty clay loam, eroded phase)	18	44	13	25	28	38	. 8	2. 2	1. 2	3. 2
Muskingum-Upshur-Brooke complex, eroded steep phases (formerly Belmont silty clay loam, eroded steep phase)										

Philo loam	27	54	12	18	18	30	1.0	1.8	1.5	2.7
Philo silt loam	27	54	12	18	20	30	1.2	1.9	1.5	2.7
High-bottom phase	27	55	15	22	22	32	1.2	1.9	1.5	2.7
Pope fine sandy loam	15	30	12	20	22	30	.7	1.7	1.7	2.7
Pope loam	30	48	15	24	25	32	1.5	2.5	2.0	3.0
High-bottom phase	30	45	18	24	25	32	1.5	2.5	2.0	3.0
Pope silt loam	33	60	18	24	25	32	1.7	2.5	2.4	3.5
High-bottom phase	30	55	18	26	25	32	1.7	2.5	2.4	3.5
Rarden silt loam	25	48	15	25	25	40	1.0	1.7	1.5	3.0
Eroded phase	15	38	12	18	20	30	.6	1.4		2.5
Very gently sloping phase	30	50	15	28	25	40	1.0	1.8	2.0	3.0
Riverwash										
Seepy land (Muskingum and Keene soil materials)										
Tilsit silt loam	24	48	12	23	27	40	1.1	2.0	1.5	3.0
Tuscarawas silt loam	25	45	12	23	20	35	1.0	1.8	1.5	3.0
Eroded phase	18	35	9	18	16	25	.6	1.4	1.0	2.5
Tyler silt loam [2]	15	36	10	15	18	30	.5	1.5		2.0
Tyler silty clay loam [2]	15	30	10	12	15	25	.5	1.5		2.0
Upshur-Muskingum complex (formerly Meigs silty clay loam)	28	45	14	26	25	40	1.0	1.8	1.5	3.2
Upshur-Muskingum complex, eroded phases (formerly Meigs silty clay loam, eroded phase)	16	35	12	21	20	30	.6	1.4	1.0	2.6
Wayland silt loam [2]	18	40			20	32	.7	1.4		2.0
Wellston silt loam	33	57	15	27	30	45	1.2	2.2	2.0	3.1
Shallow phase	30	56	15	25	25	40	1.0	1.8	2.0	3.0
Eroded shallow phase	18	45	12	20	20	30	.6	1.4		2.5
Sloping phase	30	55	15	25	25	40	1.0	1.8	1.5	3.0
Wooster silt loam	35	60	24	35	38	45	1.2	1.7	2.7	3.2
Gently undulating phase	30	55	20	32	35	40	1.0	1.6	2.4	3.0
Zaleski silt loam	26	57	14	27	22	35	1.0	1.8	1.2	2.8

[1] Highest pasture rating is 10, which is equivalent to 210 animal-unit-days per acre, or about
A are yields under ordinary use and treatment; in columns B, under improved use and treatment.
[2] Artificial drainage is required for production of rotation crops.

The estimates in table 16 are based primarily on interviews with farmers, the county agent, members of the Ohio Agricultural Experiment Station, direct observation by members of the soil survey party, and results obtained on experimental farms by the Ohio Agricultural Experiment Station. They are presented only as estimates of average yields that can be expected over a period of years, according to the two broadly defined types of management. Naturally these yields will not be obtained on every field or in every year, as a soil shown on the map may vary somewhat from place to place, management practices will differ slightly from farm to farm, and climatic conditions fluctuate from year to year. Nevertheless, these yield estimates are as reasonable as can be made from present evidence and show the relative productivity of the various soils.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development acting on parent material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief or lay of the land; and (5) the length of time the forces of development have acted on the material. The climate, and its influence on soil and plants, depends not only on temperature, rainfall, and humidity but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

ENVIRONMENT AND CHARACTERISTICS OF THE SOILS

Tuscarawas County lies in the region of Gray-Brown Podzolic[9] soils that occupies the east-central United States. Most of the soils have developed under a heavy forest cover of deciduous trees, with sufficient rainfall to keep them moist throughout. The climatic and biological conditions permit only a relatively thin surface accumulation of organic litter and a few inches of dark soil in the upper part of the profile. The surface mat of organic matter is thinner than in the Podzol region to the north but thicker than in the Red and Yellow Podzolic region to the south. All the soils are relatively low in organic content, and they vary from medium to strongly acid in the solum.

This county is part of the Allegheny Plateau. Bedrock formations over most of the county consist of nearly horizontal interbedded sandstone, siltstone, noncalcareous and calcareous shales, fire clay, and limestone. These formations are classified as the Allegheny and Conemaugh divisions of the Pennsylvanian geologic age. A small area in the northwestern part of the county has been covered by glacial till of Wisconsin age. The till is composed largely of sandstone and shale material.

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[9] BALDWIN, M. THE GRAY-BROWN PODZOLIC SOILS OF THE EASTERN UNITED STATES. 1st Internatl. Cong. Soil Sci., Washington, 1927, Proc. and Papers 4: 276–282. 1928.

Glaciofluvial outwash terraces are principally in the valleys of the Tuscarawas River and Sugar Creek and to less extent in the valleys of smaller streams. The damming and ponding of north-flowing streams by the glacier to the north of the county resulted in the deposition of silt and clay in the stream valleys. Subsequent lowering of these streams has resulted in extensive terraces. The terrace material consists largely of sandstone, siltstone, and shale gravels, with little limestone material.

Alluvium along the Tuscarawas River and streams flowing from the glaciated areas includes much glacial material, whereas that along streams in the nonglaciated areas has been derived largely from the sandstone, siltstone, and shale uplands.

CLASSIFICATION OF SOILS IN HIGHER CATEGORIES

The soils of the county are classified on the basis of their characteristics as (1) zonal,[10] (2) intrazonal, and (3) azonal.

ZONAL SOILS

The zonal soils have well-developed soil characteristics that reflect the active factors of soil genesis—climate and vegetation. They are represented in this county by Gray-Brown Podzolic soils.

Gray-Brown Podzolic Soils

The true Gray-Brown Podzolic soils have ABC profiles, with grayish-brown or yellowish-brown eluviated A horizons, yellowish-brown or brownish-yellow illuviated B horizons, and C horizons composed of physically weathered rock materials that are also partly chemically weathered. This group includes the well-drained, somewhat excessively drained and moderately well-drained soils of the uplands and terraces—the Wellston, Wooster, Holston, Chenango, Conotton, Tilsit, Keene, Tuscarawas, Zaleski, Canfield, Hornell, and Monongahela soils. These soils are separately discussed in the following pages.

Wellston silt loam has developed on sandstone and siltstone containing thin beds of noncalcareous shale. The following profile was observed in a cultivated field about 3 miles southwest of Gilmore, Washington Township, on a slope of about 2 percent:

A_p. 0 to 8 inches, grayish-brown smooth friable silt loam; relatively low organic matter; fine crumb structure; slightly acid.

A_2. 8 to 14 inches, brownish-yellow or grayish-yellow friable smooth silt loam; thin platy structure; crumbles readily under slight pressure; medium acid.

B_{21}. 14 to 29 inches, brownish-yellow heavy silt loam to light silty clay loam; breaks into small to medium nuciform aggregates; rock fragments absent; strongly acid.

B_{22}. 29 to 35 inches, light brownish-yellow smooth friable silt loam, slightly stained with gray and brown; strongly acid.

B_{23}. 35 to 42 inches, grayish-yellow moderately compact gritty silt loam, slightly mottled with light gray and brown; strongly acid.

C. 42 inches +, sandstone bedrock.

Variations from the above description occur in color and thickness of the various horizons and in depth to bedrock, which ranges from 30

[10] See footnote 5, p. 19.

to 50 inches. The bedrock consists of interbedded sandstone, siltstone, and noncalcareous shale. The profile, especially the B horizon, varies in texture with the bedrock formations. The shallow phase of Wellston silt loam is mapped where bedrock occurs at depths of 25 inches or less.

Wooster soils are developed on Wisconsin glacial till, which is composed almost entirely of sandstone material but does contain small quantities of shale, other rocks, and limestone material. A profile of Wooster silt loam taken 3¾ miles northwest of Dundee, Wayne Township, shows the following characteristics:

A_p 0 to 9 inches, grayish-brown friable gritty silt loam; a few small rounded gravel on the surface and throughout the horizon; medium acid.

A_2. 9 to 17 inches, light yellowish-brown friable gritty silt loam; some sandstone and shale fragments; strongly acid.

B_2. 17 to 31 inches, yellowish-brown slightly compact heavy silt loam; firm in place but only slightly heavier than the above horizon; breaks into angular aggregates about ¼ to ¾ inch in diameter; strongly acid.

C. 31 inches +, brownish-yellow friable heavy loam glacial till slightly compact in place; contains considerable number of sandstone and shale rock fragments; strongly acid.

Holston soils are developed on slack-water terrace deposits of fine sand, silt, and clay and are associated with Monongahela and Tyler soils.

Chenango soils are developed on outwash gravel and sand material and occupy terrace positions, principally in the valley of the Tuscarawas River. A representative profile of Chenango silt loam is as follows:

A_p. 0 to 8 inches, grayish-brown friable gritty silt loam; contains a small quantity of fine gravel; medium acid.

A_2. 8 to 15 inches, yellowish-brown friable silt loam; coarse crumb structure; strongly acid.

$B_{2\,1}$. 15 to 28 inches, brownish-yellow heavy silt loam or light silty clay loam: breaks into moderate-sized medium-nuciform aggregates; strongly acid.

$B_{2\,2}$. 28 to 34 inches, yellowish-brown gravelly clay loam with a faint reddish hue; slightly plastic when moist and hard when dry; contact between this horizon and material below is irregular, with tongues extending downward into the underlying gravel; strongly acid.

C. 34 inches +, gray or grayish-yellow stratified loose gravel and coarse sand, composed largely of sandstone and shale material; below a depth of 6 feet material is slightly calcareous.

Profiles of Chenango soils vary from the above description in texture, structure, and thickness of the various horizons and in depth to loose gravel and sand.

Conotton soils are developed on low terraces intermediate in position between the Chenango soils and soils of the first bottoms or flood plains. They have less well-developed profiles, are less acid, and have somewhat darker surface and subsoil horizons than Chenango soils.

The Tilsit, Keene, Tuscarawas, Zaleski, Canfield, Hornell, and Monongahela soils have grayish-brown to yellowish-gray eluviated A horizons; brownish-yellow to pale yellow illuviated upper B horizons; mottled gray, yellow and brown illuviated lower B horizons,

with a tendency toward pan, or Planosol, development; and C horizons similar to those of the other Gray-Brown Podzolic soils.

The Tilsit soil is developed on interbedded sandstone, siltstone, and noncalcareous shale and is associated with Wellston soils. It has A and upper B horizons similar to those of Wellston soils and in this respect is similar to the Gray-Brown Podzolic soils. The B horizon at a depth of about 18 to 24 inches, however, is mottled gray, yellow, and brown, with a slight siltpan or claypan development.

Keene soils are developed on noncalcareous clay shale. A profile of Keene silt loam taken south of Dundee follows:

A_1. 0 to 2 inches, dark-gray friable silt loam; relatively high organic content; slightly acid.

A_3. 2 to 7 inches, brownish-gray friable silt loam; thin platy structure; medium acid.

B_1. 7 to 13 inches, brownish-yellow smooth friable silt loam; breaks into medium-sized nuciform aggregates; medium acid.

B_{21}. 13 to 19 inches, pale brownish-yellow compact silty clay loam; breaks into strongly developed medium nuciform aggregates; cleavage faces have a thin coating of brown silty material in the upper part, changing gradually to a gray coating in the lower part of the horizon; strongly acid.

B_{22}. 19 to 28 inches, pale-brown smooth clay, mottled and streaked with light gray; well-developed coarse prismatic structural aggregates with a vertical dimension of from 3 to 4 inches; moderately plastic when moist, sticky when wet, and very hard when dry; strongly acid.

B_{23}. 28 to 50 inches, mottled gray, yellow, and brown smooth clay; breaks into large irregularly shaped clods; plastic when moist and hard when dry; strongly acid.

C. 50 inches +, mottled yellow and gray partly weathered clay shale.

Tuscarawas soils are formed from colluvial material washed from upland soil areas developed on sandstone, siltstone, and shale. Unlike the colluvial phases of Muskingum soils, which include relatively recent colluvium, the Tuscarawas material has been in place sufficiently long to develop a profile.

The Zaleski soil consists of colluvial material from upland areas of Muskingum and Keene soils deposited over slack-water terraces of Monongahela soils. It has a grayish-brown A horizon; pale-yellow or brownish-yellow upper B horizon; and mottled gray, yellow, and brown lower B horizon.

The Canfield soil has developed on noncalcareous Wisconsin drift composed largely of sandstone. It is the moderately well drained member of the catena that includes the well-drained Wooster soils. The A and upper B horizons are similar to those of the Wooster soils, but the lower B horizon is mottled, and there is a slight compaction in some areas.

The Hornell soil consists of shallow deposits (less than 36 inches) of Wisconsin glacial till over clay shale. The B horizon is heavier textured than the B horizon of the Canfield soil.

Monongahela soils are developed on slack-water deposits of silt and clay, with some sandy material. A profile of Monongahela silt loam taken half a mile east of Somerdale has the following characteristics:

A_1. 0 to 1 inch, very dark-gray silt loam; high in organic matter, with a thin overlay of partly decomposed organic matter, as leaves and twigs; slightly acid.

A_2. 1 to 8 inches, brownish-gray friable silt loam containing many small roots; weak fine crumb structure; has small worm casts and small cylinders of dark-gray material, representing old root channels; strongly acid.

B_1. 8 to 15 inches, pale-yellow friable silt loam; breaks into moderately developed fine nuciform aggregates; strongly acid.

B_{21}. 15 to 23 inches, pale-yellow heavy silt loam, slightly mottled and blotched with gray and brown; strongly acid.

B_{22}. 23 to 41 inches, pale-yellow, smooth clay, mottled with light gray and brown; breaks into strongly developed coarse blocky aggregates plastic when moist and hard when dry; strongly acid.

C. 41 inches +, mottled gray, yellow, and brown stratified clay and silt with thin layers of sand; extends to a depth of 15 feet or more.

The Gray-Brown Podzolic soils having a weakly developed profile are the Muskingum and Rarden soils and the component members of the Muskingum-Brooke, Muskingum-Upshur-Brooke, and Upshur-Muskingum complexes.

Muskingum soils are developed on interbedded sandstone, siltstone, and shale. Thus, the profile characteristics are variable and largely dependent upon the thickness of each layer of bedrock and the sequence in which the layers occur. Muskingum silt loam developed on fine-grained sandstone and siltstone in a wooded area has the following profile:

A_0. Brown or dark-brown forest litter from deciduous trees, partly decayed and composed of leaves, twigs, and branches; ½ to 1½ inches thick.

A_1. 0 to 2 inches, dark brownish-gray friable silt loam; fine crumb structure; relatively high organic content; medium acid.

A_2. 2 to 10 inches, grayish-yellow friable gritty silt loam; thin platy structure; a few small channery fragments of siltstone rock are present; strongly acid.

B_{21}. 10 to 18 inches, yellowish-brown gritty heavy silt loam; coarse crumb to weakly developed fine nuciform structure; strongly acid.

B_{22}. 18 to 22 inches, brownish-yellow gritty silt loam; contains many partly weathered siltstone fragments.

D. 22 inches +, bedrock of interbedded siltstone and fine-grained sandstone.

Rarden soils are developed on red or pale-green noncalcareous clay shale in association with Muskingum soils.

The Muskingum-Brooke complex was separated as Westmoreland soils in earlier surveys in Ohio and other States. It occurs on upland areas where soils are developed on relatively thin layers, or strata, of sandstone, siltstone, shale, and limestone. The Brooke soils are developed on the limestone, which is a minor constituent in the formation but has influenced a large part of the material.

The Muskingum-Upshur-Brooke complex was formerly correlated as Belmont soils in eastern Ohio. The bedrock consists of interbedded sandstone, siltstone, and noncalcareous and calcareous gray shale, with red clay shale and limestone as minor constituents.

The Upshur-Muskingum complex was formerly classified as Meigs soils. The bedrock formations include interbedded noncalcareous sandstone, siltstone, shale, and clay shale; greenish or reddish calcareous clay shale is a minor but important material.

INTRAZONAL SOILS

The intrazonal soils have more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the normal effect of climate and vegetation. This group includes only the Planosols.

PLANOSOLS

The Planosols represent different degrees of development of a siltpan or claypan in the B horizon and were developed under moderately good to imperfect natural drainage. The Planosols have light-gray to brownish-gray eluviated A horizons and mottled gray, yellow, and brown heavier textured illuviated upper B horizons, with siltpan or claypan development in the lower B horizons.

The Planosol group includes the Eifort and Tyler soils. Eifort soils are developed on heavy gray fire clay and have heavy-textured B and C horizons. Tyler soils are developed on slackwater silts and clays and are the imperfectly drained members of the catena that includes the well-drained Holston and the moderately well-drained Monongahela soils. Tyler soils have light brownish-gray upper A horizons, mottled lower A horizons, mottled B horizons, which are heavy textured and compact, and C horizons of stratified silt and clay.

AZONAL SOILS

Azonal soils do not have well developed profile characteristics. The Alluvial soils represent this group in Tuscarawas County.

ALLUVIAL SOILS

Alluvial soils consist of recent deposits of material. Most of them receive additional deposits when streams overflow, and therefore soil-forming processes generally have not had time to bring about the development of eluviated and illuviated horizons. The higher lying areas, however, have slight profile development.

In this county Alluvial soils fall in two groups. In the first are the strongly acid soils on alluvium washed primarily from upland areas of sandstone, siltstone, and shale and from slack-water terraces of silt and clay. In this group are the well-drained Pope, moderately well to imperfectly drained Philo, poorly drained Atkins, and very poorly drained Elkins soils. In the second group are slightly acid soils on alluvium washed primarily from glaciated uplands and outwash terraces. These are the well-drained Chagrin, moderately well drained Lobdell, poorly drained Wayland, and the very poorly drained Killbuck soils. Killbuck soil consists of light-colored alluvium over dark alluvium.

LABORATORY DETERMINATIONS

Mechanical analyses for certain soils of the county are given in table 17.

Table 17.—*Mechanical analyses of certain soils in Tuscarawas Co*

Soil type and sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sa
	Inches	*Percent*	*Percent*	*Percent*	*Perce*
Canfield silt loam:					
2741135	0–8	3. 4	3. 8	3. 7	7.
2741136	8–10	2. 2	3. 2	2. 4	5.
2741137	10–25	3. 6	3. 7	3. 3	6.
2741138	25–40	2. 1	3. 2	3. 1	8.
Monongahela silt loam:					
274164	0–1	. 7	1. 5	3. 2	5.
274165	1–8	. 5	1. 3	2. 9	4.
274166	8–18	. 3	1. 6	3. 7	6.
274167	18–23	. 2	1. 4	4. 7	10.
274168	23–47	. 0	. 2	. 4	1.
274169	47–60	. 4	. 6	. 3	.
Monongahela silt loam, light-textured subsoil phase:					
274185	0–8	. 4	2. 3	4. 1	5.
274186	8–14	. 3	2. 3	4. 3	5.
274187	14–19	. 1	1. 8	3. 7	4.
274188	19–27	. 1	2. 0	4. 5	6.
274189	27–35	. 2	6. 6	16. 5	23.
274190	35–48	0	. 6	1. 2	2.
Rarden silt loam, very gently sloping phase:					
274149	0–1	2. 2	2. 9	2. 3	5.
274150	1–6	1. 0	2. 6	1. 7	3.
274151	6–11	1. 1	2. 1	1. 5	3.
274152	11–15	1. 2	2. 3	2. 0	3.
274153	15–25	. 8	8. 3	6. 5	2.
274154	25–32	. 1	. 7	. 5	
274155	32–42	3. 2	6. 0	2. 0	1

Tilsit silt loam:					
2741124	0–8	.4	1.5	2.4	4.
2741125	8–14	.1	.7	1.3	2.
2741126	14–31	.1	.6	1.3	2.
2741127	31–43	0	1.1	1.8	4.
Wellston silt loam:					
2741101	0–8	.2	.9	1.2	1.
2741102	8–14	.1	.8	1.0	1.
2741103	14–31	.3	.6	.9	1.
2741104	31–40	.9	1.2	1.5	2.
2741105	40–45	2.1	2.8	2.7	3.
Wooster silt loam:					
274113	0–9	1.7	2.3	2.1	4.
274114	9–17	2.5	2.8	2.5	4.
274115	17–31	4.0	5.3	4.6	7.
274116	31–50	10.8	10.7	7.2	8.

APPENDIX

CORRELATION CHANGES

The concepts of soil classification have changed somewhat since this report was written, and as a result certain groups of soils in Tuscarawas County have been reclassified:

Hornell.—In recent correlations, Hornell soils have been restricted to the Podzols great soil group. The soils correlated as Hornell in Tuscarawas County are Gray-Brown Podzolic, so they will no longer be called Hornell. A name has not been assigned for them.

Chenango.—Recent correlation has restricted Chenango to the Podzols great soil group. The soils correlated as Chenango in Tuscarawas County therefore would not now be called Chenango. A name has not yet been assigned for them.

Holston.—The name Holston formerly included both Gray-Brown Podzolic and Red-Yellow Podzolic soils. The name Holston has now been restricted to Red-Yellow Podzolic soils, and the name Allegany has been given to those soils having Gray-Brown Podzolic profiles that were formerly included as Holston. The soils called Holston in this report therefore have been recorrelated as Allegany soils.

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Areas surveyed in Ohio. Reconnaissance surveys shown by northwest-southeast hatching; cross hatching indicates areas covered by both detailed and reconnaissance surveys.

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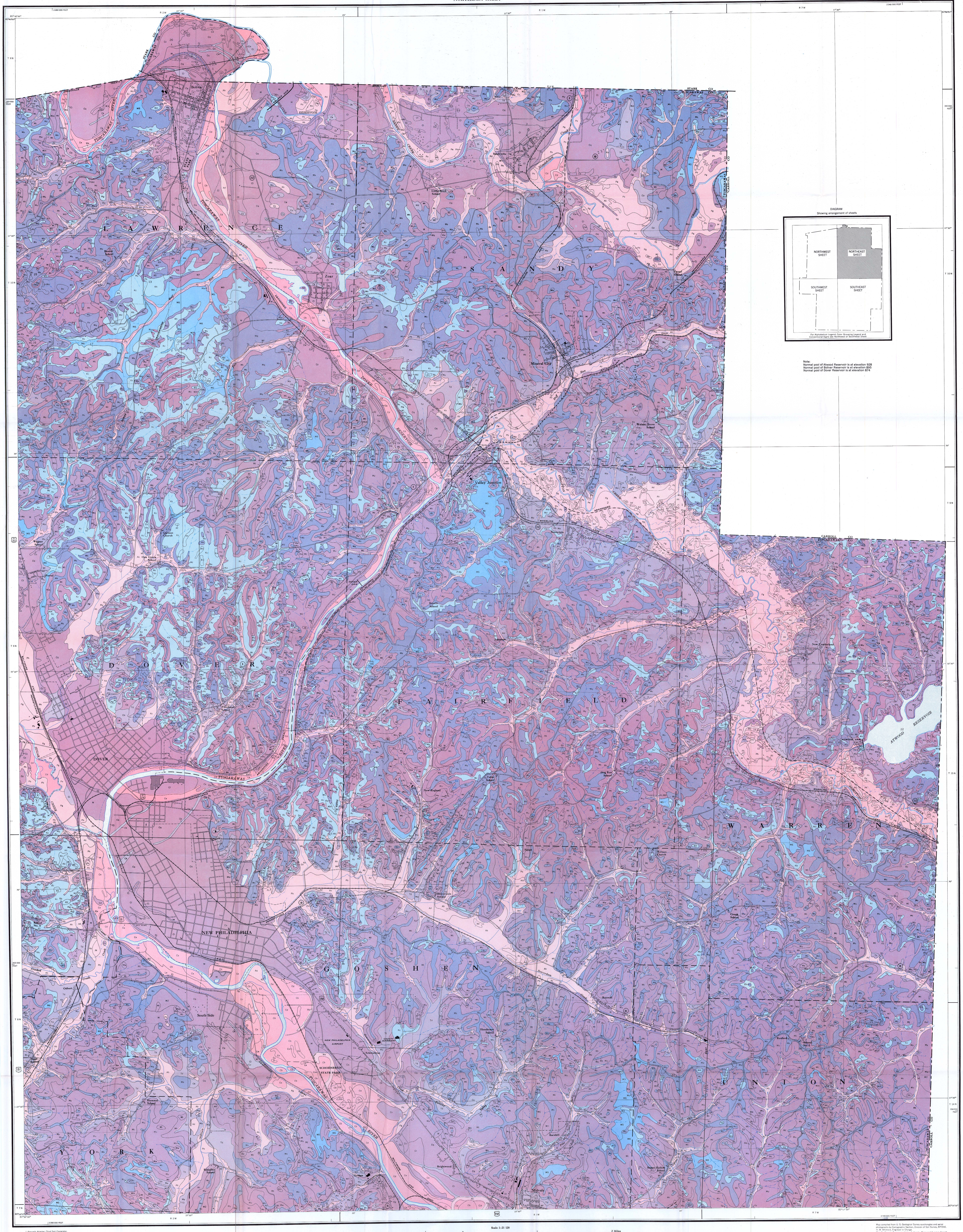
U. S. DEPARTMENT OF AGRICULTURE

SOIL MAP

TUSCARAWAS COUNTY - OHIO

NORTHEAST SHEET

OHIO AGRICULTURAL EXPERIMENT STATION



J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
E. D. Fowler, Principal Soil Correlator, Northern States.
Correlation and inspection by O. C. Rogers, Senior Soil Scientist.
Soils surveyed 1934-38 by Robert Wildermuth, in Charge,
Arthur E. Taylor and Matthew Drosdoff, U. S. Department of Agriculture,
W. S. Mozier, G. A. Mickelson and R. W. Cummings, Ohio Agricultural Experiment Station.

Scale 1:21 120

1 ½ 0 1 2 Miles

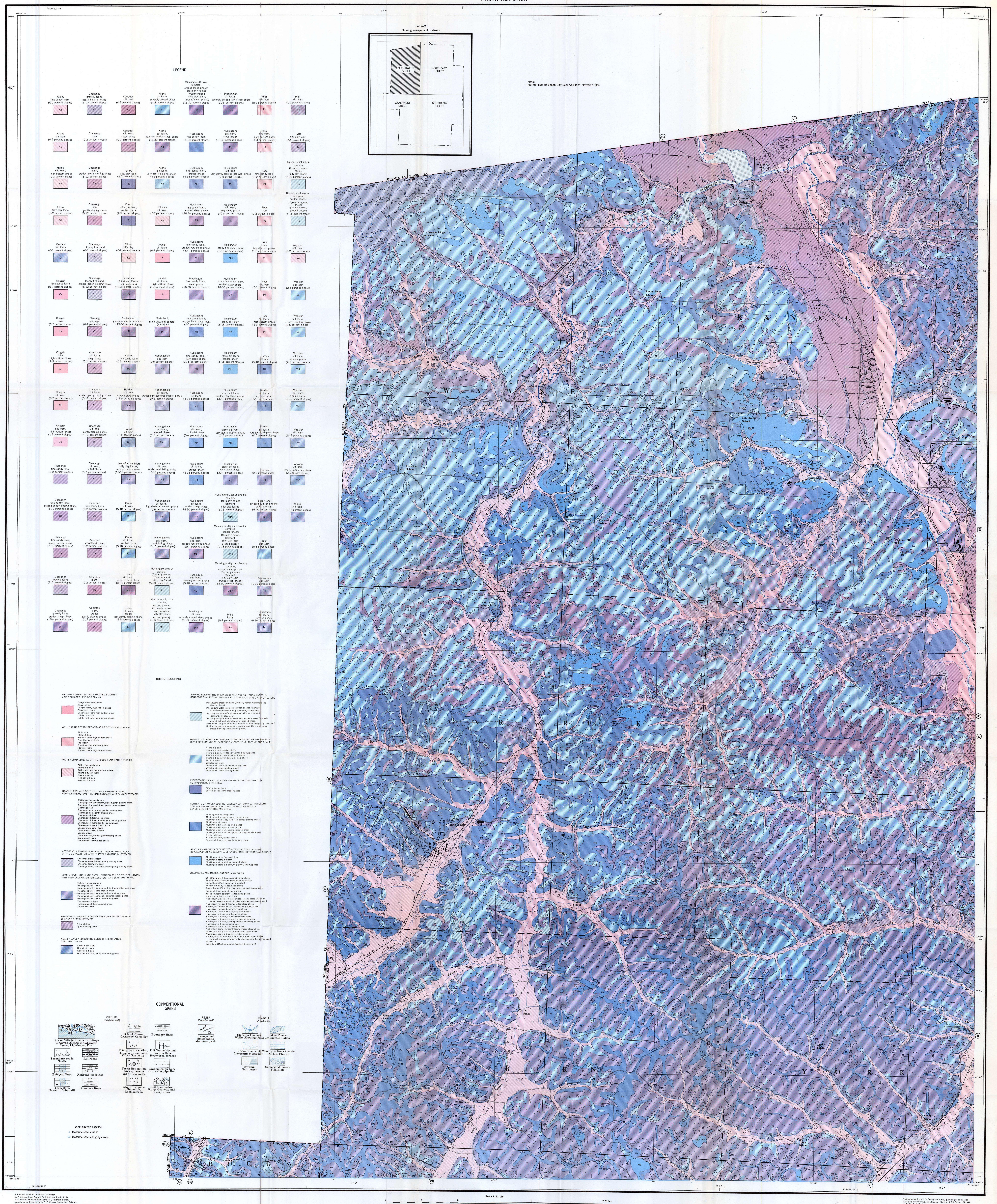
5 000 0 5 000 10 000 Feet

Map compiled from U. S. Geological Survey quadrangles and aerial photographs by Cartographic Section, Division of Soil Survey, BPISAE.
H. W. Whitlock, Engineer in Charge.
Map Drafting by Tennessee Valley Authority, Maps and Surveys Branch.
Polyconic projection. 1927 North American datum.
10 000 foot grid based on Ohio (North) rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE

SOIL MAP
TUSCARAWAS COUNTY - OHIO
NORTHWEST SHEET

OHIO AGRICULTURAL EXPERIMENT STATION



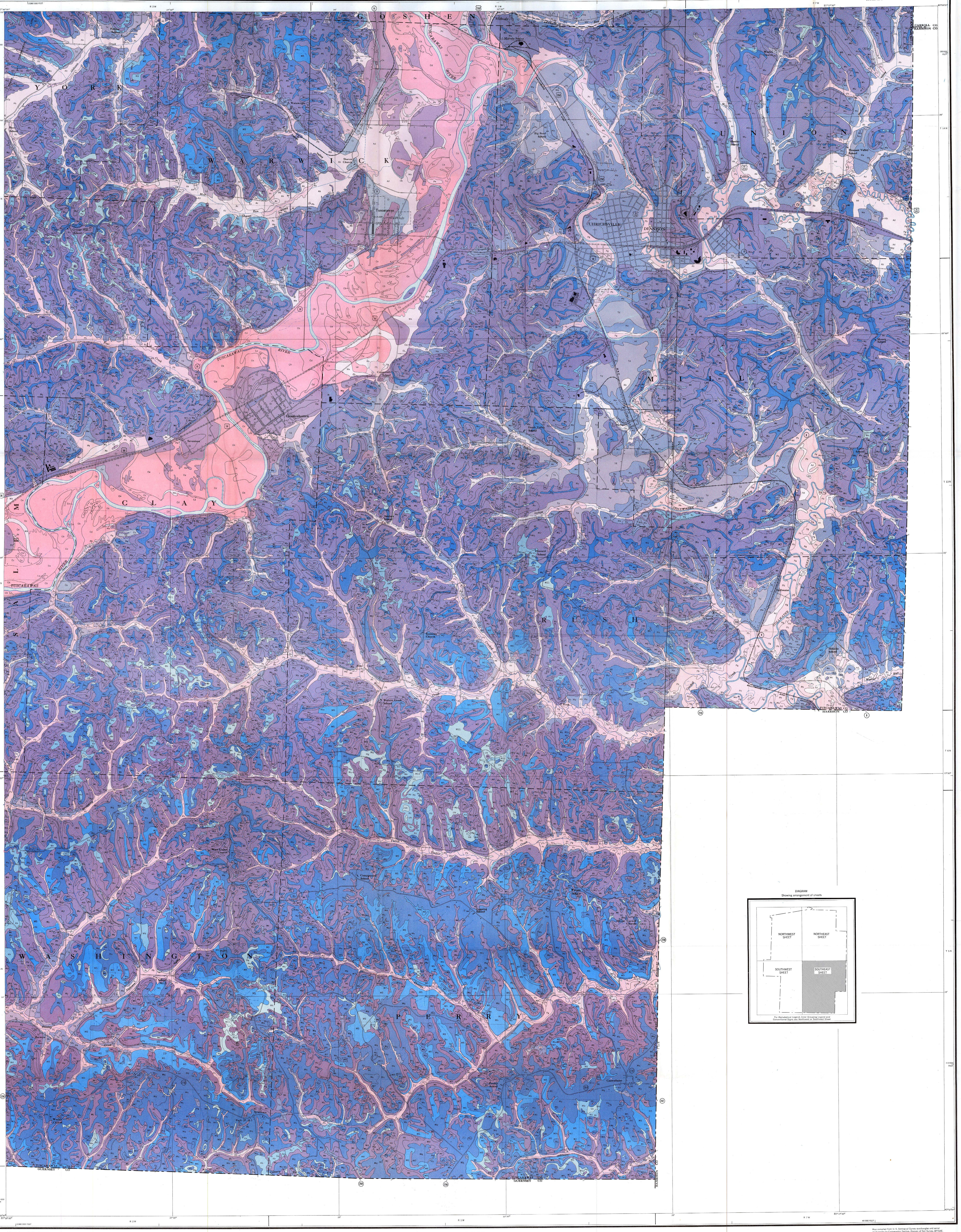
U.S. DEPARTMENT OF AGRICULTURE

SOIL MAP

TUSCARAWAS COUNTY - OHIO

SOUTHEAST SHEET

OHIO AGRICULTURAL EXPERIMENT STATION



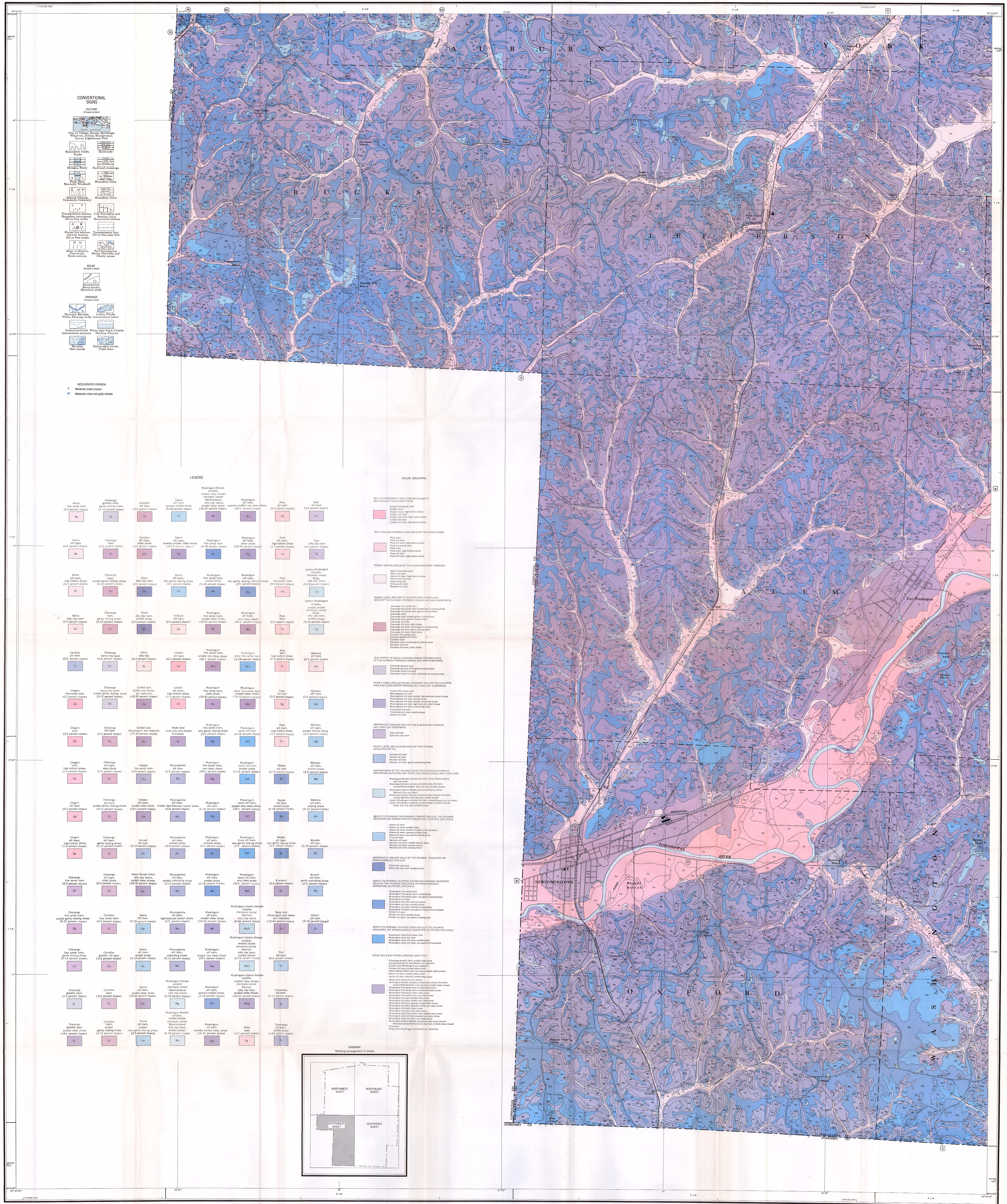
U. S. DEPARTMENT OF AGRICULTURE

SOIL MAP

TUSCARAWAS COUNTY - OHIO

SOUTHWEST SHEET

OHIO AGRICULTURAL EXPERIMENT STATION



TUSCARAWAS COUNTY, OHIO, SOILS: SUMMARY OF IMPORTANT CHARACTERISTICS

Soil	Map symbol	Physiographic position	Dominant slope	Natural drainage	Soil profile					Relative depth to parent rock	Workability	Erodibility
					Surface soil		Subsoil		Parent material or substratum			
					Color	Consistence	Color	Consistence				
			Percent									
Atkins fine sandy loam	AA	Low flood plains	0- 2	Poor	Light gray to light brownish gray.	Friable	Mottled yellow, gray, and brown.	Friable	Medium to strongly acid alluvium.	Variable but usually deep.	Easy	Low.
Atkins silt loam	AB	do	0- 2	do	do	do	do	Friable to variable	do	do	do	Do.
High-bottom phase	AC	Flood plains	0- 2	do	do	do	do	do	do	do	do	Do
Atkins silty clay loam	AD	Low flood plains	0- 2	do	do	Firm	do	Firm; plastic when wet	do	do	Moderately difficult	Do.
Canfield silt loam	C	Uplands	0- 5	Moderately good	Light grayish brown to brownish gray.	Friable	Brownish yellow; mottled below 18 inches.	Friable	Glacial till	Deep	Easy	Moderately low.
Chagrin fine sandy loam	CA	Flood plains	0- 2	Good	Light brown or grayish brown.	do	Yellowish brown	Friable to nearly loose	Slightly acid alluvium	Variable but usually deep.	do	Low.
Chagrin loam	CB	do	0- 2	do	Brown	do	Light brown; yellowish brown below 15 inches.	do	do	do	do	Do.
High-bottom phase	CC	do	1- 3	do	do	do	do	Friable	do	do	do	Do.
Chagrin silt loam	CD	do	0- 2	do	do	do	Brown; brownish yellow below 30 inches.	do	do	do	do	Do.
High-bottom phase	CE	do	1- 3	do	do	do	do	do	do	do	do	Do.
Chenango fine sandy loam	CF	Outwash terraces	0- 2	Good to somewhat excessive.	Grayish brown or light yellowish brown.	do	Yellowish brown	do	Noncalcareous to slightly calcareous gravel and sand.	do	do	Do.
Eroded gently sloping phase	CG	do	5–12	do	Brownish yellow to yellowish brown.	do	do	do	do	do	Moderately easy to moderately difficult.	Moderate to moderately high.
Gently sloping phase	CH	do	5–12	do	Grayish brown or light yellowish brown.	do	do	do	do	do	do	Moderately high.
Chenango gravelly loam	CI	do	2- 5	Excessive	do	do	Brownish yellow to yellowish brown.	do	do	do	Easy	Moderately low.
Eroded steep phase	CJ	do	18+	do	do	do	do	do	do	do	Difficult	High.
Gently sloping phase	CK	do	5–10	do	do	do	do	do	do	do	Moderately easy	Moderately high.
Chenango loam	CL	do	0- 2	Good to somewhat excessive.	do	do	do	Friable to moderately firm.	do	do	Easy	Low.
Eroded gently sloping phase	CM	do	5–12	do	Brownish yellow to yellowish brown.	do	do	do	do	do	Moderately easy	Moderately high.
Gently sloping phase	CN	do	5–12	do	Grayish brown or light yellowish brown.	do	do	do	do	do	do	Moderate to moderately high.
Chenango loamy fine sand	CO	do	0- 5	Good to excessive	Grayish brown or grayish yellow.	Loose	Yellowish brown; grayish yellow below 32 inches.	Loose	do	do	Easy	Low.
Eroded gently sloping phase	CP	do	5–12	Excessive	Yellowish brown	do	do	do	do	do	Easy to moderately difficult.	Moderately high.
Chenango silt loam	CQ	do	0- 2	Good to somewhat excessive.	Grayish brown to light yellowish brown.	Friable	Yellowish brown; dark brown below 25 inches.	Moderately friable to firm.	do	do	Easy	Low.
Deep phase	CR	do	0- 2	Good	do	do	do	do	do	do	do	Do.
Eroded gently sloping phase	CS	do	5–12	Good to somewhat excessive.	Brownish yellow to yellowish brown.	do	do	do	do	do	Moderately easy to moderately difficult.	Moderately high.
Gently sloping phase	CT	do	5–12	do	Grayish brown	do	do	do	do	do	do	Low.
Silted phase	CU	do	0- 3	Good	Brown to dark brown	do	do	do	do	do	Easy	Do.
Conotton fine sandy loam	CV	do	0- 2	Good to somewhat excessive.	Light yellowish brown	Very friable	Yellowish brown	Friable	Noncalcareous to slightly calcareous old alluvium.	do	do	Do.
Conotton gravelly silt loam	CW	do	0- 2	Good	Brown or yellowish brown	Friable	Light brown; reddish brown below 16 inches.	Friable to somewhat firm	do	do	Moderately easy	Do.
Conotton loam	CX	do	0- 2	Good to somewhat excessive.	Grayish brown to brown	do	Pale reddish brown to yellowish brown.	do	do	do	do	Do.
Eroded gently sloping phase	CY	do	5–12	do	Pale reddish brown to yellowish brown.	do	do	do	do	do	Moderately easy to moderately difficult.	Moderate to moderately high.
Conotton silt loam	CZ	do	0- 2	do	Grayish brown to brown	do	Light yellowish brown; pale reddish brown below 16 inches.	Moderately friable to moderately firm.	do	do	Easy	Low.
Silted phase	C2	do	0- 2	Good	do	do	do	do	do	do	Moderately easy	Very low.
Eifort silty clay loam	EA	Uplands	2- 5	Imperfect	Light grayish brown	Slightly plastic when wet	Light brownish gray; mottled below 12 inches.	Plastic when wet	Noncalcareous fire clay	Variable but relatively shallow.	Moderately difficult	Very high.
Eroded phase	EB	do	2- 5	do	Light brownish gray	Plastic when wet	Mottled yellow and gray	do	do	do	Difficult	Do.
Elkins silty clay	EC	Flood plains and slack-water terraces.	0- 2	Very poor	Dark brownish gray to dark gray.	Sticky when wet	Dark gray, mottled with yellow and brown.	do	Medium to strongly acid alluvium.	Variable but usually deep	Impractical unless artificially drained.	Very low.
Gullied land: Eifort and Rarden soil materials	GA	Uplands	18–30	Imperfect					Noncalcareous fire clay or clay shale.	do	Impractical	Very high.
Muskingum soil material	GB	do	15–30	Excessive					Noncalcareous sandstone, siltstone, and shale.	do	do	Do.
Holston fine sandy loam	HA	Slack-water terraces	0- 5	Good	Light yellowish brown to grayish brown.	Friable	Brownish yellow; yellow below 16 inches.	Friable to somewhat firm	Noncalcareous silt and clay; some sand and gravel.	Relatively shallow	Easy	Low to moderate.
Holston silt loam, eroded steep phase	HB	do	18+	do	do	do	Yellowish brown	do	do	Variable but usually deep	Difficult	High.
Hornell silt loam	HC	Uplands	2–15	Moderately good to imperfect.	Grayish brown to brownish gray.	do	Light brownish yellow; mottled below 18 inches.	Moderately firm to firm; plastic below 18 inches when wet.	Glacial till shallow over clay shale.	Moderately shallow	Moderately easy to moderately difficult.	Moderately low to moderately high.
Keene-Rarden-Eifort silty clay loams, eroded steep phases.	KA	do	18–30	Keene: Moderately good. Rarden: Excessive. Eifort: Imperfect.	Keene: Light brownish gray. Rarden and Eifort: Light grayish brown.	Keene and Rarden: Friable. Eifort: Slightly plastic when wet.	Keene: Grayish yellow, pale yellow below 12 inches. Rarden: Yellowish brown, reddish brown below 16 inches. Eifort: Light brownish gray mottled below 12 inches.	Keene: Friable to moderately firm. Rarden: Friable to firm, plastic when wet in lower part. Eifort: Plastic when wet.	Keene: Noncalcareous clay shale. Rarden: Noncalcareous clay shale. Eifort: Noncalcareous fire clay.	Keene: Variable but moderately shallow. Rarden: Moderately shallow. Eifort: Variable but relatively shallow.	Keene and Rarden: Moderately easy to moderately difficult. Eifort: Moderately difficult.	Keene: Moderate to moderately high. Rarden: Moderately high. Eifort: Very high.
Keene silt loam	KB	do	5–18	Moderately good	Light brownish gray to yellowish gray.	Friable	Grayish yellow; pale yellow below 12 inches.	Friable to moderately firm.	Noncalcareous clay shale	Variable but moderately shallow.	Moderately easy to moderately difficult.	Moderate to moderately high.
Eroded phase	KC	do	5–18	do	Light brownish yellow	do	do	do	do	do	do	Moderately high.
Eroded steep phase	KD	do	18–30	do	do	do	do	do	do	do	Difficult	High.
Eroded very gently sloping phase	KE	do	2- 5	do	do	do	do	do	do	do	Easy	Moderate.
Severely eroded phase	KF	do	5–18	do	do	do	do	do	do	do	Moderately difficult	Moderately high.
Severely eroded steep phase	KG	do	18–30	do	Pale yellow	Moderately friable	do	do	do	do	Difficult	High.
Very gently sloping phase	KH	do	2- 5	do	Light brownish gray	Friable	do	do	do	do	Easy	Moderately low.
Killbuck silt loam	KK	Flood plains crossing the slack-water terraces.	0- 2	Very poor	Grayish brown or brownish gray.	do	Very dark brownish gray; mottled below 18 inches.	Moderately firm to firm	From slightly acid alluvium underlain by lacustrine deposits.	Shallow to deep	Difficult unless artificially drained.	Very low.
Lobdell silt loam	LA	Flood plains	0- 2	Moderately good	Grayish brown to pale yellow.	do	Brownish yellow; mottled below 18 inches.	Friable	Slightly acid alluvium	do	Easy	Moderately low.
High-bottom phase	LB	do	1- 3	do	do	do	Brownish yellow; mottled below 20 inches.	do	do	do	do	Do.
Made land, mine pits, and dumps	M	Uplands and terraces	Variable	Variable					Variable	Variable, not underlain by parent rock.	Impractical	Variable but usually high.
Monongahela silt loam	MA	Slack-water terraces	0- 5	Moderately good	Grayish brown to light brownish gray.	Friable	Light brownish yellow; mottled below 18 inches.	Moderately firm to firm	Noncalcareous silt and clay (some sand and gravel).	Moderately shallow	Easy	Low to moderate.
Eroded light-textured subsoil phase	MB	do	0- 5	do	Pale yellow to light brownish yellow.	Moderately friable to moderately firm.	Brownish yellow; mottled below 18 inches.	Variable (stratified silt, fine sand, and gravelly material).	do	do	do	Do
Eroded phase	MC	do	0- 5	do	Pale yellow	do	Light brownish yellow; mottled below 18 inches.	Moderately firm to firm	do	do	do	Moderate to moderately high.
Eroded undulating phase	MD	do	5–10	do	do	do	do	do	do	do	Moderately easy to moderately difficult.	High.
Light-textured subsoil phase	ME	do	0- 5	do	Grayish-brown to light brownish gray.	Friable	Brownish yellow; mottled below 18 inches.	Variable (stratified silt, fine sand, and gravelly material).	do	do	Easy	Low to moderate.
Undulating phase	MF	do	5–10	do	do	do	Light brownish yellow; mottled below 18 inches.	Moderately firm to firm	do	do	Moderately easy to moderately difficult.	High.
Muskingum-Brooke complex (formerly Westmoreland silty clay loam).	MG	Uplands	5–18	Excessive	Muskingum: Light yellowish gray. Brooke: Brownish gray.	Muskingum: Friable. Brooke: Plastic when wet.	Light brownish yellow	Muskingum: Friable. Brooke: Plastic when wet.	Muskingum: Noncalcareous sandstone, siltstone, and shale. Brooke: Limestone.	Shallow	Difficult to impractical	Do.
Muskingum-Brooke complex, eroded phases (formerly Westmoreland silty clay loam, eroded phase).	MH	do	5–18	do	Muskingum: Light yellowish brown. Brooke: Light brownish yellow.	do	do	do	do	do	do	Do.
Muskingum-Brooke complex, eroded steep phases (formerly Westmoreland silty clay loam, eroded steep phase).	MI	do	18–30	do	do	do	do	do	do	do	Very difficult to impractical.	Very high.
Muskingum fine sandy loam	MJ	do	5–18	do	Light grayish brown or grayish yellow.	Friable	Light yellow or light brownish yellow.	Friable	Noncalcareous sandstone, siltstone, and shale.	do	Moderately easy to difficult.	High.
Eroded phase	MK	do	5–18	do	Light brownish yellow to yellowish brown.	do	do	do	do	do	do	Do.
Eroded steep phase	ML	do	18–30	do	Light brownish yellow	do	do	do	do	Very shallow	Very difficult to impractical.	Very high.
Eroded very steep phase	MM	do	30+	do	do	do	do	do	do	do	Impractical	Do.
Steep phase	MN	do	18–30	do	Light grayish brown or grayish yellow.	do	do	do	do	Shallow	Very difficult to impractical.	High.
Very gently sloping phase	MO	do	2- 5	Somewhat excessive	do	do	do	do	do	do	Easy	Moderately high.
Very steep phase	MP	do	30+	Excessive	do	do	do	do	do	Very shallow	Very difficult to impractical.	High.
Muskingum silt loam	MQ	do	5–18	do	Yellowish gray to brownish gray.	do	Brownish yellow	do	do	Moderately shallow to shallow.	Moderately easy to moderately difficult.	Moderate to high.
Colluvial phase	MR	do	5+	Somewhat excessive	Grayish brown	do	do	do	Colluvium from other Muskingum soils.	Moderately deep	Easy	Do.
Eroded phase	MS	do	5–18	Excessive	Light yellowish brown	do	do	do	Noncalcareous sandstone, siltstone, and shale.	Shallow	Moderately easy to difficult.	High.
Eroded steep phase	MT	do	18–30	do	do	do	do	do	do	do	Difficult	Very high.
Eroded very steep phase	MU	do	30+	do	do	do	do	do	do	do	Very difficult	Do.
Severely eroded phase	MV	do	5–18	do	do	do	do	do	do	do	Moderately difficult to difficult.	High.
Severely eroded steep phase	MW	do	18–30	do	do	do	do	do	do	Very shallow	Difficult to impractical	Very high.
Severely eroded very steep phase	MX	do	30+	do	do	do	do	do	do	do	Impractical	Do.
Steep phase	MY	do	18–30	do	Light yellowish gray	do	do	do	do	Shallow	Difficult to impractical	Do.
Very gently sloping colluvial phase	MZ	do	2- 5	Somewhat excessive	Grayish brown	do	do	do	Colluvium from other Muskingum soils.	Moderately deep	Easy	Moderate.
Very steep phase	M2	do	30+	Excessive	Light yellowish gray	do	do	do	Noncalcareous sandstone, siltstone, and shale.	Very shallow	Impractical	Very high.
Muskingum stony fine sandy loam	M3	do	5–18	do	Light grayish yellow	do	do	do	do	Shallow	do	High.
Eroded steep phase	M4	do	18–30	do	Light brownish yellow	do	do	do	do	do	do	Do.
Muskingum stony silt loam	M5	do	5–18	Somewhat excessive	Light yellowish gray	do	do	do	do	do	Very difficult to impractical.	Do.
Eroded phase	M6	do	5–18	Excessive	Light yellowish brown	do	do	do	do	Very shallow	Impractical	Do.
Eroded very steep phase	M7	do	30+	do	do	do	do	do	do	do	do	Very high.
Very gently sloping phase	M8	do	2- 5	Somewhat excessive	Light yellowish gray	do	do	do	do	Shallow	do	Moderately high.
Very steep phase	M9	do	30+	Excessive	do	do	do	do	do	Very shallow	do	Very high.
Muskingum-Upshur-Brooke complex (formerly Belmont silty clay loam).	M10	do	5–18	Good to excessive	Muskingum: Light yellowish gray. Upshur: Light brown. Brooke: Brownish gray.	Muskingum: Friable. Upshur: Moderately plastic when wet. Brooke: Plastic when wet.	Muskingum and Brooke: Light brownish yellow. Upshur: Reddish brown.	Muskingum: Friable. Upshur and Brooke: Plastic when wet.	Muskingum: Noncalcareous sandstone, siltstone, and shale. Upshur: Calcareous clay shale. Brooke: Limestone.	Shallow	Moderately easy to difficult.	High.
Muskingum-Upshur-Brooke complex, eroded phases (formerly Belmont silty clay loam, eroded phase).	M11	do	5–18	do	Muskingum and Brooke: Light brownish yellow. Upshur: Light reddish brown.	Muskingum: Friable. Upshur and Brooke: Plastic when wet.	do	do	do	do	do	Do.
Muskingum-Upshur-Brooke complex, eroded steep phases (formerly Belmont silty clay loam, eroded steep phase).	M12	do	18–30	Excessive	do	do	do	do	do	do	Very difficult to impractical.	Very high.
Philo loam	PA	Flood plains	0- 2	Moderately good	Light grayish brown	Friable	Light brownish yellow; mottled below 20 inches.	Friable	Medium to strongly acid alluvium.	Variable but mostly deep	Easy	Low.
Philo silt loam	PB	do	0- 2	do	do	do	Light brownish yellow; mottled below 18 inches.	do	do	do	do	Do.
High-bottom phase	PC	do	1- 3	do	do	do	do	do	do	do	do	Do.
Pope fine sandy loam	PD	do	0- 2	Good	do	Very friable	Yellowish brown	Very friable	do	do	do	Do.
Pope loam	PE	do	0- 2	do	do	Friable	do	Friable	do	do	do	Do.
High-bottom phase	PF	do	1- 3	do	do	do	do	do	do	do	do	Do.
Pope silt loam	PG	do	0- 2	do	do	do	do	do	do	do	do	Do.
High-bottom phase	PH	do	1- 3	do	do	do	do	do	do	do	do	Moderately low.
Rarden silt loam	RA	Uplands	5–18	Excessive	do	do	Yellowish brown, reddish brown below 16 inches.	Friable to firm; plastic in lower part when wet.	Noncalcareous clay shale	Moderately shallow	Moderately easy to moderately difficult.	Moderately high.
Eroded phase	RB	do	5–18	do	Light grayish brown to reddish brown.	Moderately friable to moderately firm.	do	do	do	do	Moderately difficult to difficult.	High.
Very gently sloping phase	RC	do	0- 5	do	Light grayish brown	Friable	do	do	do	do	Moderately easy	Moderately high.
Riverwash	RD	Flood plains	0- 2	Variable					Mixture of gravel, sand, and silt.	Variable	Impractical	High.
Seepy land (Muskingum and Keene soil materials).	SA	Uplands	15–40	Poor	Variable	Variable	Variable	Variable	Muskingum: Noncalcareous sandstone, siltstone, and shale. Keene: Noncalcareous clay shale.	Moderately shallow to shallow.	Impractical unless drained.	Variable.
Tilsit silt loam	TA	do	0- 5	Moderately good	Light grayish brown	Friable	Light brownish yellow; mottled below 24 inches.	Friable	Noncalcareous sandstone, siltstone, and shale.	Variable but usually relatively deep.	Easy	Low.
Tuscarawas silt loam	TB	Colluvial fans of the uplands.	2–12	do	Grayish brown	do	Light yellowish brown	Moderately friable to moderately firm.	Colluvium from soils derived from sandstone, siltstone, and shale.	Moderately deep	Moderately easy to moderately difficult.	Moderate to moderately high.
Eroded phase	TC	do	5–20	do	Light yellowish brown	Moderately friable	do	do	do	do	Moderately difficult to difficult.	Moderately high to high.
Tyler silt loam	TD	Slack-water terraces	0- 2	Imperfect; usually requires artificial drainage for cultivated crops.	Light brownish gray	Friable	Mottled gray, yellow, and brown.	Moderately friable; slightly plastic when wet below 14 inches.	Noncalcareous silt and clay; some sand and gravel.	Usually moderately deep	Moderately easy	Moderately low.
Tyler silty clay loam	TE	do	0- 2	do	do	Slightly plastic when wet	do	Plastic when wet	do	do	Moderately easy to moderately difficult.	Do.
Upshur-Muskingum complex (formerly Meigs silty clay loam).	UA	Uplands	5–18	Good to excessive	Upshur: Light reddish brown. Muskingum: Light yellowish gray.	Upshur: Moderately plastic when wet. Muskingum: Friable.	Upshur: Reddish brown. Muskingum: Light brownish yellow.	Upshur: Plastic when wet. Muskingum: Friable.	Upshur: Calcareous clay shale. Muskingum: Noncalcareous sandstone, siltstone, and shale.	Shallow	Moderately easy to difficult.	High.
Upshur-Muskingum complex, eroded phases (formerly Meigs silty clay loam, eroded phase).	UB	do	5–18	do	Upshur: Reddish brown. Muskingum: Light brownish yellow.	Upshur: Plastic when wet. Muskingum: Friable.	do	do	do	do	Difficult	Do.
Wayland silt loam	WA	Low flood plains	0- 2	Poor	Gray	Friable	Mottled gray, yellow, and brown.	Friable	Slightly acid alluvium	Variable but usually relatively deep.	Impractical unless artificially drained.	Very low.
Wellston silt loam	WB	Uplands	2- 5	Good	Grayish brown	do	Yellowish brown; brownish yellow below 25 inches.	Friable to moderately friable.	Noncalcareous sandstone, siltstone, and shale.	Relatively deep	Easy	Low to moderate.
Eroded shallow phase	WC	do	2- 5	do	Light brownish yellow	do	Yellowish brown	do	do	Moderately shallow	do	Do.
Shallow phase	WD	do	2- 5	do	Grayish brown	do	do	do	do	do	do	Do.
Sloping phase	WE	do	5–12	do	do	do	Yellowish brown; brown below 20 inches.	do	do	Relatively deep	Easy to moderately difficult.	Moderate to high.
Wooster silt loam	WF	do	5–18	do	do	do	Light brown; brownish yellow below 16 inches.	do	Glacial till	Deep	do	Do.
Gently undulating phase	WG	do	2- 5	do	do	do	do	do	do	do	Easy	Moderately low.
Zaleski silt loam	ZA	Colluvial fans on slack-water terraces	5–18	Moderately good	do	do	Light brownish yellow; mottled below 18 inches.	Moderately friable to firm.	Colluvium from soils derived from sandstone, siltstone, and shale and deposited on slack-water silts.	Shallow to moderately deep.	Moderately easy to difficult.	Moderate to high.